With This Issue
Classified Section - p98
Software Security Supplement.

.EXE

The Software Developers' Magazi

FEBRUARY 1992 VOL 6 ISSUE 8

Don't judge us by our cover -
This issue we look at Clipper.

Where do we go from five-oh?
The Clipper language grows up.

How to persist TBrowse objects.

There are four new regular columns,
To please C lovers and C haters.

Five Programmer's Editors compared.

And, oh yes, there's Microsoft's C++.
An exclusive try-out of a Beta called Pete.

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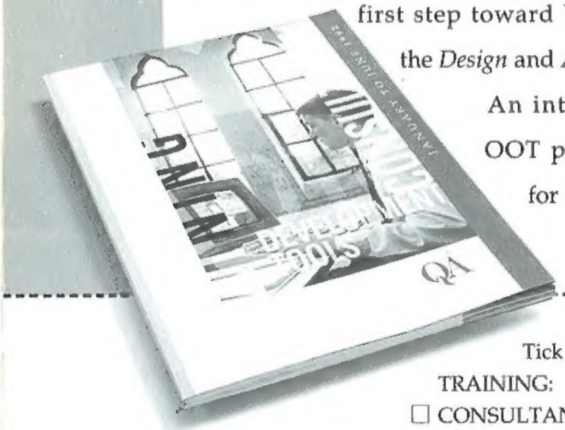

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CIRCLE NO. 426

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Pronunciation

The name of .EXE Magazine is pronounced to rhyme with 'not sexy magazine'.

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Issue theme: Clipper

The metaphor that went wrong

John Barber isn't happy with the way computers treat files.

When you use metaphors that are familiar and real-world based, users can transfer previous knowledge of their work environment to your application interface. You must be careful in choosing a metaphor to make sure the metaphor meets the expectations users have because of their real world experience. - Common User Access Advanced Interface Design Guide.

If you were asked to think of an example where this advice had been successfully applied, what would you choose? The first thing which comes to my mind is the spray can of a Paint program. The user's real world knowledge can be transferred in such an obvious way that it must be very unusual for anyone to reach for the manual. You just pick up the can and press the button.

Unfortunately, not all metaphors are this successful. One in particular has suffered from inconsistency and poor implementation. It's been around a lot longer than the spray can, and it's so widely used that it's easy to forget it is a metaphor. It is ...FILE.

I don't know who first used the word in connection with computers, but no doubt they were likening computer storage to the traditional office filing cabinet. Yet it seems that this potentially helpful metaphor has been obscured by later developments. In modern GUI application programs, a standard format File Menu has emerged, in conformance with CUA guidelines, but even here, close scrutiny reveals some serious flaws.

First, the menu seems to be designed to keep the user in the dark about what is really happening. One important concept which all users need to be aware of is that programs operate on a working copy of data, not the original. There is nothing difficult about this. If we were modifying a document manually using a pen, it would be sensible to take a photocopy and work on that, leaving the original document safely in its file until we were happy with the modification. Programs do the same. Yet many inexperienced users must be fooled by commands such as File Open and File Print, and believe that they are working directly on the contents of the file. For them, opening up a file is rather like a surgeon opening up a patient.

This difficulty could be fixed quite easily by some rewording of the menu items. A further problem becomes apparent if we take the manual editing analogy a little further. After we have created the modified document, we can file it and destroy the original. But sometimes, we may choose to keep the original also, at least for a while. This too is a common event in our real world experience. The equivalent action on the standard file menu, 'File Save As ...', is hardly intuitive, and the user has the inconvenience of having to think up a new name for what may be just a new version of the same thing.

Having multiple versions of documents is such a natural idea in our real world experience that it should be an intrinsic part of any computer filing system worth its salt. The concept of version control is just as relevant to the users of application programs as to the software developers who create the programs.

Why should users, who may be non-technical, be expected to navigate around a tree-structured directory system? Once we introduce tree-structured filing systems, 'File' as a metaphor begins to loose its consistency. Filing cabinets do not grow on trees.

Obviously, files need to be organised in some way. The important thing is the interface which is presented to the user. To locate a file, it should simply be a matter of stating what we know about it, eg that it is a letter and that it was written by Jim. The problem with path names is that \JIM\LETTERS and \LETTERS\JIM do not mean the same thing. The ordering of the information which occurs in a path name is quite unnecessary for the user's purposes.

It seems to me that while many aspects of software usability have improved dramatically, those related to files have been sadly neglected. At the heart of the problem is the implementation of a metaphor in a way which doesn't meet anyone's expectations.

EXE

John Barber was once a respectable mechanical engineer, but his reputation was ruined by a brief but passionate affair with a Hewlett Packard 9825A in the early 1980's. Since then he has indulged in many programming excesses and is now reduced to a life of toil and poverty as a freelance programmer.

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THE C LANGUAGE

Refer also to the C++ section.

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CIRCLE NO. 427

News

Village People

Don't forget the Windows Show 1992, billed as the UK's largest ever software event, which is to be staged at Olympia 2, London from 18th-20th February. A central attraction will doubtless be the .EXE Development Tools Village; the big names in Windows development will all be represented, including Microsoft, Borland and Symantech. For more information call IT Events Ltd on 0256 381456.

Eiffel comes to DOS

Would you like to be into OOP, but don't fancy something that's got C in it? German company SiG GmbH has released Eiffel/S, a DOS implementation of V3.0 of the language. The Eiffel/S compiler outputs C code - so you'll still need a C compiler - and comes with a set of basic class libraries which include classes for I/O, persistence and data structures. Prices start under £400, more info from UK distributor Applied Logic Developments (081 7801088).

Blinker outgrows Clipper

Blink Inc has begun shipping Blinker V2.0, the latest release of the popular dynamic overlay linker. This now integrates a memory swapper, using EMS/XMS memory to enable an executing program to generate a DOS shell for running a second program. There is also support for several languages including Microsoft C, Watcom C, Zortech C++, Borland C++, Clipper V5.01 and Assembler. Blinker costs £189 and is distributed in the UK by QBS on 081 9944842.

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VB to SQL Server

Microsoft has shipped its Visual Basic Library and SDK for SQL Server. The RRP is £335, Microsoft is on 0734 500741.

Clarion buys out JPI

Clarion Software and UK-based Jensen & Partners International (JPI) have announced an intent to merge the two companies. The merger will be accomplished by issuing Clarion stock to JPI stockholders. Clarion is an American company, based in Florida, which develops 4GL database application development tools for DOS, including Clarion Professional Developer and Clarion Report Writer. JPI is practically the last bastion of British-based mainstream compiler development. The company develops the TopSpeed family of languages comprising Pascal, Modula-2, C and C++ optimising compilers that share a common code generator and IDE.

JPI has been collaborating with Clarion for the last two years to include its compiler/link technology into V3.0 of Clarion's Professional Developer 4GL (due to ship in Q1 '92). The takeover comes as no surprise to industry-watchers who have recently speculated that JPI was spreading itself too thinly with so many compilers to support and maintain (at one time the company was planning to develop an Ada compiler as well).

JPI was founded in 1987 by Niels Jensen, a co-founder of Borland International, and five other former Borland developers. The development staff of JPI will remain in London and will be known as the TopSpeed Institute, which will continue to develop and maintain the company's language products. Financial details of the merger were not disclosed.

Still de-fluffing C

When Gimpel Software releases a new version of PC-lint - the program which takes all the fun out of C programming, by reporting the very code inconsistencies which make that language such a joy to use - we usually get to print a few lines of superficially ok (but actually hopelessly bug-ridden) code, so that You the Reader can test your expertise. The example provided with PC-lint 5.0, however, is too long for this. Never mind.

The two new features which Gimpel is emphasising are stronger type checking and an extreme sensitivity to uninitialised variables - the latter achieved by an algorithm which follows control flow through the code. Other listed improvements include a rude message when `floats` are tested for equality (you laugh, but I've known many a proper, *paid* programmer do this) and a 'handsome new manual sporting real section numbers'.

Gimpel is based in the US, so for UK prices we phoned Grey Matter (0364 53499) who quoted us £80 ex VAT for the DOS-OS/2 version and £130 for the (faster, larger capacity) 386 DOS-extender version.

The Muse of objects

Persistent Objects & Extended database Technology (POET) is a low-cost C++ object-oriented DBMS for DOS, Windows, Interactive UNIX and the NeXT operating environments. There is a single API for all platforms and database files are binary-compatible across the different systems.

Developed by Berlin-based software house BKS, the POET system implements C++ language extensions (such as `persistent`, `transient` and `index` keywords) through a pre-compiler which generates C++ v2.0 source code and header files. These are then compiled along with the user's application code by a native C++ compiler. The pre-compiler also supports templates for containers. In addition, there are various utilities supplied including a class browser (graphical under Windows) and a version control system for the class dictionary.

Complete database facilities are provided including complex selection through predefined query classes, sorting and navigation. The company is presently working on a multi-user client/server version of the product.

Currently, most object-oriented databases are available only on high-end UNIX systems and are often prohibitively expensive. The single-user POET development system for Windows costs just £299 (versions are available for Borland C++ 2.0 and Zortech C++ 3.0 compilers). It is distributed in the UK by Silicon River, a company recently set up by ex-Zortech directors and headed by former Zortech MD Paul Leathers. Silicon River is on 081 3177777.

One all

In a US court, Intel has failed to get an injunction against Cyrix, a manufacturer of competitively-priced 80x87 clone coprocessor chips, to prevent Cyrix from shipping its coprocessors. Part Two: Intel has succeeded in getting an injunction against ULSI, also a manufacturer of competitively-priced 80x87 clone coprocessor chips, preventing ULSI from shipping *its* coprocessors. Both disputes concern alleged infringements of Intel's patents.

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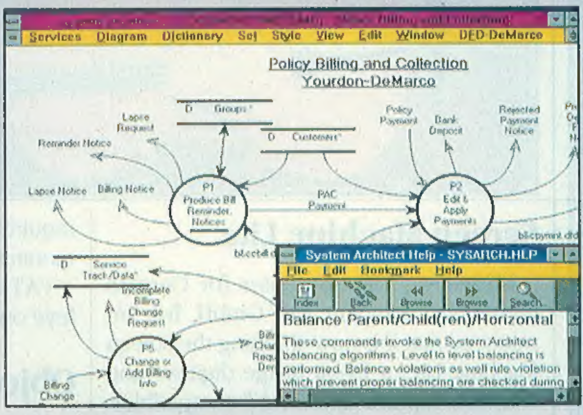

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Oil and Water

If you're having peculiar problems with code compiled with Borland C++ V3.0 and linked to a library generated by Borland C++ V2.0, then stop trying. Binaries produced by V3.0 are (potentially) incompatible with V2.0; you must recompile library source from scratch, or contact your library supplier for an upgrade. This applies to Borland's Turbo Vision and OWL libraries, too.

Real Time Lib++

Capsule is a new general purpose C++ class library from Microtec Research. It contains a selection of container classes, such as singly and doubly linked lists, circular lists, stacks, queues and heterogeneous linked lists etc. Capsule also provides error detection and application specific classes derived from these base classes, including classes to handle PostScript or graphics output and string/numeric conversions etc. Applications developed under Capsule can be debugged using Microtec's own Xray debugger. Capsule costs £390. Microtec is on 0256 57551.

Energize C/C++

The Energize system from Lucid Inc is a new Client/Server C/C++ programming tool set for SPARC workstations which integrates into the UNIX environment and provides object-oriented development tools. The tool set contains the GNU Emacs editor and the GNU debugger, as well as Lucid's own C and C++ compilers which provide incremental compiling. The Server part of Energize provides an object-oriented database for storing the all the program information when more than one developer is working on the code. Several browsing tools have also been included to simplify the navigation through code. Energize costs $3250 for a single user licence and is distributed by Lucid Inc on 010415 3298400.

Foxy CodeBase

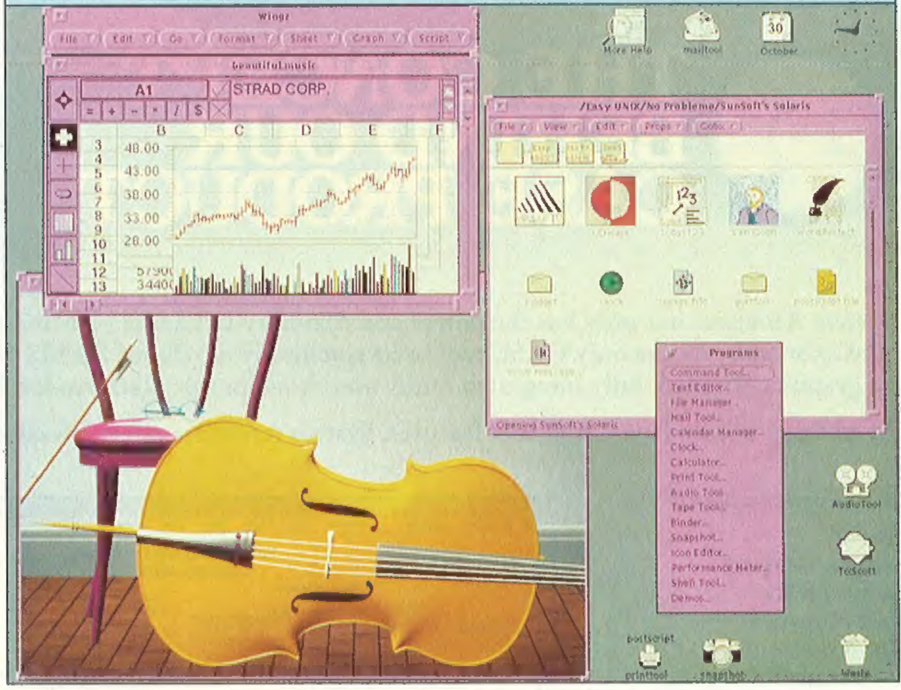
CodeBase V4.5 is the latest incarnation of Sequiter's multi-user database management library for C, C++, Visual Basic and Turbo Pascal for Windows. In addition to supporting dBASE, Clipper and FoxPro, CodeBase now supports dBASE IV and FoxPro V2.0 CDX compound index file formats. Fox's new CDX format significantly reduces the size of index files which means that less data has to be read or written to disk. This results in applications that run faster. CodeBase V4.5 costs £255 and is distributed in the UK by The Software Construction Company on 0763 244114.

Solaris

Sunsoft, the system software subsidiary of Sun Microsystems, has introduced a new 32-bit operating system called Solaris which will be available on both the Intel 80x86 and SPARC platforms. Applications developed for Solaris on these platforms will be source code compatible, enabling developers to write applications capable of running on both platforms (the source code will only need to be re-complied).

Solaris is based on SunOS V4.1.1 (which incorporates UNIX System V Release 4) and offers a 32-bit multi-tasking, multi-processing and multi-threading operating system. It provides an Open Look desktop with 14 applications including a file manager, networked calender and a mail application. The Solaris development environment includes a C compiler, XGL graphics libraries and 57 F3 fonts. Network administration is simplified using the ONC (Open Network Computing) protocols which can run on all major operating systems including DOS and VMS. This enables distributed applications to be developed across heterogeneous networks.

Solaris V1.0 for the SPARC platform is currently only available to OEMs. Sunsoft expects to ship Solaris V2.0 in the third quarter of 1992. This will support both Intel and SPARC platforms. For more information contact Sunsoft on 0494 472900.



ADVANCED BUSINESS GRAPHICS

Screen Machine Lite

Magnifeye, UK distributor for German multimedia company Fast GmbH, has announced that it is now shipping the Screen Machine Lite, a 24-bit image digitiser and real time capture card for AT-compatibles. The Lite comes with a complete image capture application called Screen Machine Photo which enables users to grab frames of video from almost any video source. The same software, which runs under Windows 3.0, allows the captured images to be cropped and compressed using the JPEG standard and converted into one of the 15 image formats supported (including TIFF, GIF, PCX, RLE and TGA). Colour balance and saturation can also be adjusted.

Screen Machine Lite supports NTSC, PAL, VHS and S-VHS so that camcorders, VCRs and laserdisks can all be used, including the Canon Ion still video camera. The card fits into a 16-bit slot in any AT-compatible and requires 2 MB RAM, a mouse and a VGA monitor. The card plus software costs £495 + VAT and can be purchased from Magnifeye on 071 2218024.

ObjectStore for Windows

Previously available only on UNIX platforms, ObjectStore object-oriented database management system (ODBMS) is now available in a Windows version. 1992 looks like being the year of the ODBMS with ObjectStore for Windows being the second Windows-hosted product to be released in the last two months (see POET elsewhere in News).

Developed by American company ObjectDesign, ObjectStore for Windows is available in standalone and LAN-based client/server versions. The product has three principal components: the run-time ODBMS, the application interface (API) and a set of C++ development tools.

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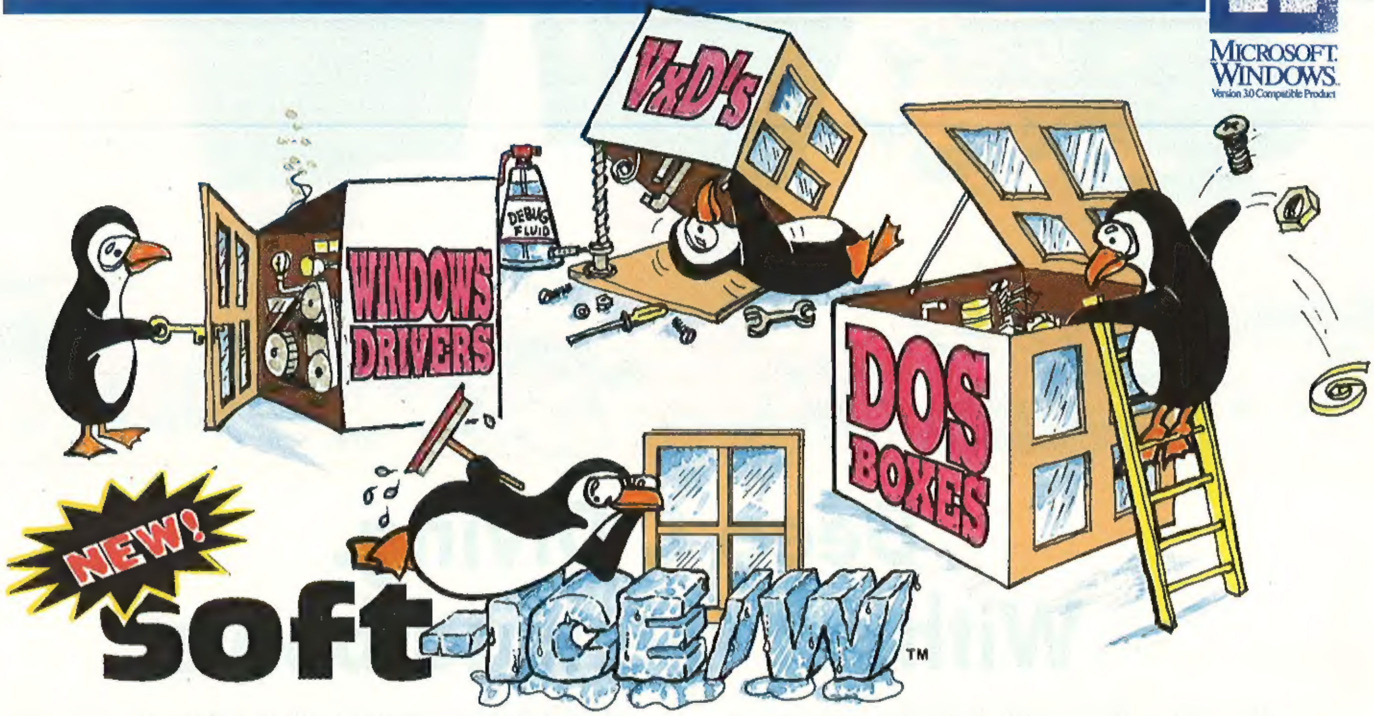

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WHAT THE EXPERTS ARE SAYING

"Soft-ICE for Windows is great! It helped me find, in fifteen minutes, a killer bug in a Windows virtual device driver that had eluded two people for several months. I can't see doing Windows development of any kind -- whether writing Windows applications, device drivers, or even DOS programs that have to run under Windows -- without it. In addition to being great for finding bugs, Soft-ICE for Windows has been essential for my work on a forthcoming book: on Undocumented Windows. Soft-ICE for Windows goes anywhere and does everything, so it's essential for anyone who wants to poke around inside Windows Enhanced mode. DOS programmers will find it a perfect way to learn how the Windows DOS extender and DPMI server work, and how Windows interacts with DOS. Windows Enhanced mode is the hacker's paradise of the 90s, and Soft-ICE for Windows is the tool that every serious Windows or DOS hacker will need. Nu-Mega has done a brilliant job!"

Andrew Schulman
Software Engineer, Phar Lap Software
Editor, Undocumented DOS
Coauthor, Undocumented Windows (forthcoming)

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CIRCLE NO. 430

The run-time environment performs all necessary object management and storage. The client/server implementation supports all NetBIOS-based PC networks (eg Novell, Banyan VINES and LAN Manager) and PC NFS for interoperability among PC and UNIX-based systems.

The API provides access to the run-time system using either a C or C++ library interface. All popular C and C++ compilers are supported including Borland C++, Microsoft C and Zortech C++.

Windows-hosted development tools consist of SchemaDesigner - a graphical database design tool, and The Browser - a tool for inspecting the contents of an ObjectStore database.

Unlike the POET ODBMS, ObjectStore for Windows doesn't come cheap. A standalone (single-user) development kit will leave a hole in your pocket the size of £3,495. Multi-user network versions start at £10,000. ObjectStore for Windows is available in the UK from Sema Software Technology on 0249 656194.

Faster Windows

The GainTEC GXA card is a new high-performance graphics adapter which is specifically designed to improve the performance of applications running in a GUI environment. The company claims that the card will deliver a 40% improvement over IBM's XGA card on Windows-based software, and is up to 10 times faster than most Super VGA cards. It plugs into either a 16-bit AT-type (ISA) slot or a 32-bit EISA slot and comes with 1 MB on-board VRAM.

Like IBM's XGA, the GXA provides dedicated hardware support for the major GUI functions using high-level commands, and thus eliminates most CPU and I/O intensive operations. All standard display resolutions are supported up to 1280 x 1024 in 16 colour mode, 1024 x 768 (non-interlaced) in 256 colours and 640.x 480 in 65,536 colours. A comprehensive range of software drivers is supplied with the card, providing support for most major GUIs, CAD systems and DOS applications. It is 100% VGA-compatible and offers full backward compatibility with CGA, HGC and MDA.

The GXA costs £345 + VAT and is available from Scene Double on 081 9583639.

DOMS

HyperDesk has unveiled its Distributed Object Management System (DOMS) which provides software developers with a set of tools for building and integrating distributed applications over a number of platforms including PCs, workstations and servers. Based on the Object Management Group's Object Request Broker (ORB) standard, DOMS is claimed to simplify object access in APIs, Remote Procedure Calls, network protocols and operating systems. It runs under both DOS and UNIX and supports Windows and Motif.

The HyperDesk Distributed Object Management System Development Kit costs $1995 (single user licence). Contact HyperDesk Corporation on 010508 3665050 for more information.

Dolphin Libs

The Dolphin C Toolkit is a C library for Microsoft C and Borland C/C++ which contains 225 miscellaneous functions including printer functions that interface with the DOS print spooler to allow background printing and functions for determining the type of disk present and for performing a software reboot. A Far Memory Manager and Debugging Library contains functions for analysing the far heap plus routines which dynamically allocate multi-dimensional arrays at run-time. The Dolphin C Toolkit costs $149 and the Far Memory Manager costs us $99. For more information contact Dolphin Software on 010510 4643009.

.EXE in 1992

You may notice some changes in this month's .EXE Magazine. Our readership survey suggested that C programmers wanted more C stuff, whereas non-C programmers wanted *anything* else. To try and accommodate everybody, we have replaced 'Code Page' with four new regular columns. '!C' (ie 'logical NOT C') is for practical, codey articles in anything except C; 'xBASE' is a *pied-à-terre* for the Foxy and the Clipperish and friends; 'Laine Stump's C++ Diary' will also be down-to-earth; and 'CUG' will provide a point of contact with the C User's Group, with the European C++ User's Group to follow soon. 'The Third Side' retires from our regular line up, although we hope to bring it back from time to time as a 'Special'. Stalwart columnists Peter Collinson and Jules May plough their lonely furrows as before.

When you have had a look at our efforts and cast this magazine aside in disgust, please write and tell us exactly why we should have left well alone, and anyway .EXE is not half as good as it was two years ago. Our *Letter of the Month* competition, now sponsored by Just Computer Books, offers a £20 book voucher as the prize for the best letter; writing fawning letters will not help you win it. Well, maybe.

Soft Mouse

NoMouse is a software replacement for the mouse, providing precise pixel control in Windows applications. It enables users of laptops and notebooks - not to mention those whose rodent has bust - to run Windows applications efficiently, without the need for a physical mouse. It includes the EasyFind utility which enlarges the standard mouse pointer, making it easy to see on LCD screens. It allows you to use short-cut keys to move quickly to the sides and corners of a window. NoMouse costs £39.95 and is distributed by GuildSoft on 0752 606200.

Affordable CASE

Personal-SELECT SSADM is a low-cost DOS-based CASE tool that provides support for both versions 3 and 4 of the SSADM methodology. The usual CASE features are all supported including data flow diagrams, entity life histories, logical data structures and, of course, a data dictionary. Versions are also available which support Yourdon and HOOD methodologies. Personal-SELECT costs £495 for a single-user version and £995 for a multi-user network version. It is published by SELECT Software on 0242 226553.

Watcom GO Pen

Watcom has announced an agreement with the GO Corporation, under which Watcom will supply the 32-bit C compiler for GO's PenPoint Software Development Kit. PenPoint is an object-oriented operating system, specifically designed for pen-based computing. The Watcom compiler is hosted under DOS or OS/2 and enables the development of applications for PenPoint on 32-bit Intel 80x86 systems. Version 1.0 of the PenPoint SDK is due to ship in the first quarter of this year.

Maastricht Conference

No, not another EC summit. The Fourth International Conference on Image Processing and its Applications (IPA), organised by the Institution of Electrical Engineers, will be held in Maastricht in the Netherlands from 7-9 April 1992.

More Shareware

We looked at EMS's C++ shareware library in our November '91 issue; now the company has introduced two new libraries: WINLIB (MS-Windows utilities, drivers, interesting bitmaps etc) and dBUtility (includes programs for dBASE III/IV, FoxPro, Clipper etc). Both libraries are US $149 ex delivery, call 0101 301 924 3594.

Letters

We welcome short letters on any subject that is relevant to software development. Please write to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. Unless your letter is marked 'Not for Publication', it will be considered for inclusion in this section.

A Typical Reader...

Sir,

I was very pleased to read the results of the .EXE Readership Survey. Although I did not take part in it, as a relatively new subscriber, I should like to congratulate the team for the innovative way (disk based) and the effort gone into obtaining unbiased results.

Needless to say that I match the results of the survey to an uncomfortably close degree in practically every aspect, except that I am now 50 and currently unemployed.

I entered software engineering about 12 years ago from electronics by designing embedded system controllers and data acquisition systems, a skill for which demand fell off very rapidly.

Networking is now the name of the game, but without formal qualifications in Computer Studies I would have remained a 'grease-monkey' had it not been for my courage to enroll at Middlesex Poly for a fresh HND.

However, my recent efforts on job hunting have revealed that prospective employers prefer youngsters with minimal experience, although us old-timers, for not a lot more, would seem to offer much better value for money.

Since the bulk of your readership is middle-aged, it would be a very interesting to research into the future prospects of 45+ ages by finding out how the existing ones are doing.

Last, but not least, I should like to congratulate all the staff for the excellent presentation of the magazine and especially for the editorial manner adopted, which makes everything fun to read.

The introduction of classified ads will benefit both the magazine and the industry it serves, especially during these hard days.

Mr C Papazissimou
London NW2

OS/2 Babel

Sir,

I read with interest BJ Thomson's article on character sets *(Software Sans Frontières, .EXE December 1991)*. I have two points to make.

First, OS/2 PM programmers do **not** need to write their own equivalents for the `AnsiNext()` and `AnsiPrev()` functions - OS/2 comes with two functions, `WinNextChar()` and `WinPrevChar()`, to do this. OS/2 also has `WinUpperChar()` and `WinUpper()` which convert a single character or a string of characters into upper case. For some unknown reason, however, there is no lower case equivalent!

Second, one problem which was not explicitly mentioned was the input and display of numbers with decimal points. We English speakers are used to using a period ('.'), but many other languages use a comma. Writers of programs to be portable to other countries need to beware of code such as:

```
sscanf( ipbuf, "%f",
                    &fval);
```

since `sscanf()` will expect the input buffer to contain a period and will not process input containing a comma correctly.

As a further complication, other languages use the period, or some other character, where we use a comma to separate thousands. So, for example, 1024 can be written as '1,024' in English, whereas natives of many other countries in Europe would prefer '1.024'.

It is a shame that, as far as I am aware, no standard PM function exists to provide the equivalent of `WinQueryDlgItemShort()` for floating point numbers. Perhaps systems developers stick to integers!

Roger Orr
London

Stepstone

Sir,

Your recent article 'Of Bullets and Muskets' *(.EXE, October 1991)* by Al Roth, printed information that was not only erroneous, but extremely damaging to the reputation of The Stepstone Corp.

In this article Dr Brad Cox, ex-Chief Technical Officer of Stepstone, was quoted as saying 'Stepstone is essentially out of business... it's reasonably public.' At no time was Stepstone out of business.

In April 1991, Stepstone went through a major financial reorganisation. Since that time, for the first time in the history of the company, Stepstone is surviving without the funding of venture capital groups. We continued to support our customer base throughout the reorganisation.

We have hired back ex-employees, and are announcing three new products in the first quarter of 1992; Objective-C for the Macintosh, the Objective-C Interpreter for the SUNs, and ICpak 101 for the NeXT station.

The enthusiasm of our employees and their belief in the superior technical attributes of our products has kept our company alive and growing.

K K Tan
President
The Stepstone Corporation
USA

We apologise for printing potentially misleading information, and are happy to set the record straight - Ed.

QEMM saga #5

Sir,

I am able to confirm the claim by the Quarterdeck MD *(.EXE Letters, Nov '91)* that users keep stumbling over 'unpromoted' features. However, these may not be quite as fabulous as he believes.

A year ago I returned a Quarterdeck 'more info' coupon and ringed several Bingo cards, all to no avail. It took a mildly sarcastic letter to obtain information on QEMM and DESQview. The products were ordered, but on delivery a disk proved faulty. So did a replacement set. The third set was OK but the auto-install was not. It made various errors, some as elementary as copying QEMM386.SYS to a \QEMM directory, but omitting this path from its CONFIG.SYS modifications. Other errors were less obvious. The machine was a new, 'clean' 386 with 8 MB RAM so there were no complications. Now I have found that Quarterdeck has no record of my registration card. A letter to Quarterdeck setting out the above in more detail has yet to bring a response.

What of the products themselves? No complaints about QEMM, once the install errors had been traced and corrected. The clarity of the manuals is not helped by the excessive repetition of the company brand names. Over 20 per page is typical, on one page I have noticed 26 mentions. DESQview has proved less useful than anticipated. Perhaps I could use it more often - I should like to use it with Windows without it crashing on exit - but the time spent removing the wrinkles often becomes greater than the maximum time it could possibly save in actual use. Investments, whether of time or money, need to be justified by results.

Mr Poel says he would like .EXE readers to be more positive. Perhaps he could set us an example first?

Bob Rimmington
Burgess Hill

DR-DOS 6.0 is ok

Sir,

I am writing to you with reference to Ian Butterworth's letter *(.EXE Nov '91).* His client had apparently experienced problems running Clipper Summer '87 programs under DR-DOS 6.0. I find this rather puzzling. My company, A C K Data, has several applications amounting to around 5 MB of source code, all in Summer '87, which have been running under DR-DOS V6.0 for the last month with no problems whatsoever.

I wonder if Mr Butterworth's clients' computer was running with data compression? Our systems are set up with no data compression, but we are running the disk cache and task-switcher. In a computer with more than 1 MB RAM, DR-DOS will use the expanded memory, or will set up extended memory to look like expanded memory (using EMM386.SYS or EMMXMA.SYS), depending on the options selected during installation. If expanded memory exists, Clipper software will use it - potentially causing a conflict with software such as the disk cache or task-switcher. Stop Clipper using expanded memory by entering

```
SET CLIPPER=E0
```

at the DOS prompt. Normally, use of LIM memory should not cause this sort of problem - it's just that Clipper Summer '87 (I suspect) may not be too well behaved in this area.

I would be interested to hear from anyone else who may have experienced difficulties running either Summer '87 or V5.01 under DR-DOS V6.0.

Michael Towle
A C K Data
Nottingham

We also understand that Summer '87's handling of expanded memory is bugged - Ed

Bugwatch

Sir,

Further to Dave Riley's letter *(.EXE, June 1991)*, I have tracked down another potentially dangerous bug in the Microsoft C 'optimising' compiler V6.0. The bug only occurs with optimisation on (default) and is demonstrated by the following program (small memory model):

```
#include <stdio.h>

static char output, input = 4;

void main(void)

{
  unsigned x;
  int  fd, fh, fm, fs;
  char da, ho, mi, se;

  da = (char) (x + 1);
  ho = (char) (x + 2);
  mi = (char) (x + 3);
  se = (char) (x + 4);

  output =
        (char) ( 10 * input );
  printf("%d", (int)output);

  fs = fd + se;
  fm = mi + fs
  fh = ho + fm;
}
```

The program should of course print out 40, but the value that actually gets output is unpredictable and depends on the contents of the DH register when `main()` is entered.

Examination of the assembly code produced by the compiler reveals that the optimiser correctly 'ignores' the first four and last three instructions (since they only operate on local data they are redundant). If these lines are taken out of the source file, however, the compiler generates correct code! The error occurs because the compiler is trying to use a 'clever' method of multiplying by 10, thus avoiding use of the `MUL` instruction. Although using the `MUL` instruction would result in faster and smaller code for a 286 or 386 processor, the compiler still insists on doing it this way when the /G2 switch (generate 286 code) is used!

The moral of this and the conclusion we have come to here is always to disable optimisation when using MS C V6.0.

Patrick Johns
AGB International
London

PCL #1

Sir,

My December copy of .EXE was accompanied by a subscription invitation. Hmm! Possible, until I read the rubbish offered by Peter Flynn as a review of PCL.

We have software running in over 20 countries using the PCL run-time environment, no licence issues here. All of it uses communications, via PSTN, Public Packet Switching, in-house PADS, and the like... Peter Flynn 'wasn't able to make it (the terminal emulator) work anywhere.'

His is the sort of review that gives 'academic computing' a bad name in the commercial environment.

My subscription? Take it out of the fee that you paid for three pages of shredder fodder.

Russell Hunt
Managing Director
Applications Systems
Hampshire

PCL #2

Sir,

I read with much interest your review of the PCL compiler/interpreter in the December issue. I've been using PCL regularly since 1988, both for my work with IPS and for the independent work I do for some other news organisations. I've all but thrown out my other compilers because PCL is so fast and easy to use and has assembler functions to do the nasty stuff.

The main comment I would like to make to the review's author is that the Terminal function in PCL has **never** failed me. Most of my work involves RS-232 communications, so almost the first thing I do when I sit down in front of a client's computer is run Terminal and look at the serial ports. It **always** works, just like everything else with PCL, and it's dead easy. I can't imagine what he was doing wrong unless he had nothing connected to the port.

I do, however, heartily agree with him that it is a shame PCL doesn't allow the generation of .EXE and .COM files. But for his information, and that of your readers, I should point out that the run-time module of PCL may be distributed without any license fees, as the PCL documentation points out.

I have done this numerous times and once - when I ran up against an early Tulip 286 on which it wouldn't run (and which Tulip later admitted was making some spurious BIOS calls) - I had recourse to the Calend help line and found it offered straight away the information I needed. They only found it natural that I had distributed the run-time module to my client.

John Clements
Technical Director
IPS
London

We apologise for the inaccuracies in the PCL article - Ed.

Hypermedia

Sir,

I was interested to read the article by Dr Pickard, and also the letter published in your column by Jules May *(.EXE Nov '91 and Dec '91).*

It is our belief that hypermedia, and applications of these techniques to communications, will have a tremendous impact on our everyday lives and I found both Richard Pickard and Jules May's articles very thought provoking.

However, it is not easy to distinguish between teaching and learning or entertainment if you take arguments used when discussing hypermedia to their logical conclusion.

After all, we have only recently finished riding the wave of consumerism which has fuelled the development of the personal computer and funded practically every other activity in our modern day society.

In a consumer society, training is just a way of instructing its members how to produce more efficiently. Advertisements are just a way of training its members how to consume products more efficiently.

Most entertainment on our TV screens each night is merely the soft selling of products, even if the goods are not paraded before us as they are in game shows. The values we must aspire to as good consumers are certainly put before us or suggested in everything from *EastEnders* to *The South Bank Show.*

For the last 40 years we have gradually become what we consume, and the communications industry has grown fat by feeding off the consumers' and producers' need to communicate. It will, therefore, be interesting to see what effect multimedia and hypermedia has on our society.

Peter Kruger
Digithurst Ltd
Herts

Letter of the Month

We have a hot, new sponsorship deal for 1992! The writer of the best letter of the month, as judged by the Editor, will receive a £20 Book Voucher, courtesy of Just Computer Books. The best letter is the one printed first. Please note that letters submitted to this page may be edited.

Why Choose?

Between Relational and Network when Raima Data Manager has both and now MUCH MORE

The Raima Data Manager dbms is intended for use by the professional C applications developer. Raima is written in C and provides a complete set of sophisticated development tools that feature:

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- Mainframe functionality
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- Royalty-free run-time distribution
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Raima provides both Relational and Network model technology for programming flexibility. Retrieve a record using the relational keyed access method and all related records can be immediately available using the network database model.

db_QUERY provides SQL-like access to **Raima**, callable from within an application, **db_REVISE** allows restructuring of live databases.

Raima is fast. Access times for retrieving data are largely independent of the size of the database.

Raima is portable. Develop an application in any environment and your database access code can be ported without change to any other supported environment. Currently, **Raima** supports MSDOS, MS Windows, OS/2, QNX, UNIX System V and Berkeley, Ultrix and VMS.

Raima Data Manager dbms is a product of Raima Corporation and has been sold to thousands of C programmers in over 50 countries. **Raima** is fully supported in the UK and Eire by Systemstar Ltd. Comprehensive training is available together with bespoke system development. At Systemstar we offer **C-scape 3®** screen interface library with Look and Feel™ from Liant Software Corporation to provide **Raima** programmers with a complete application development environment.

For more information about Raima Data Manager dbms, db_QUERY, db_REVISE and C-scape 3 call Systemstar in Hertford on (0992) 500919.

FEATURES	YES	NO
Single and multi-user available	✓	
Relational B-tree indexing	✓	
Network database model	✓	
Multiple database access	✓	
Referential integrity	✓	
Transaction processing	✓	
Automatic recovery	✓	
Record and file locking	✓	
RAM resident		✓
Relational Query and report writer	✓	
Total database redesign/restructuring	✓	
C compilers: most supported	✓	
C ++ compatible	✓	
Operating Systems: VMS, Ultrix,	✓	
UNIX, BSD, SunOs, QNX	✓	
MSDOS, OS/2	✓	
Windows 3	✓	
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Practically browsing with Clipper 5.01

Nantucket's Clipper 5.01 is worth getting to grips with if you're prepared to leave your old xBASE code behind. James Ormrod shows why with a configurable, saveable TBrowse.

Nantucket's Clipper 5.01 has proved to be a bit of an enigma: less than fully object oriented, more than just another xBASE product, a little C-like and not at all like dBASE, the Clipper '87 developer moving to 5.01 needs to do more than just assimilate extra features and functions - he needs to absorb a whole new philosophy and probably change their programming style.

The key to making the move to 5.01 is to 'think modular', to enlist 5.01's new features as allies in the battle against complexity, and to reject some of the old Summer '87 features.

Why bother? As always, it depends on your needs. If you want to knock something up for a one-off user quickly use a 4GL or grab a copy of Dataease or Foxbase. If you want to construct a core business or complex application that will have a wide distribution and a long life, use Clipper 5.01. The resulting system will be robust, fast, easily maintainable and extensible. If you should then go on to develop more applications you'll be able to reuse large chunks from the previous one, a situation that gets better and better the more applications you develop.

Reusability has been described as the 'Holy Grail' of software development, but is actually a by-product of modular design. If you 'think modular' your code will automatically be reusable. The rest of this article looks at combining Clipper 5.01's new features with modular design to build a reusable file browser with an object-oriented flavour.

5.01 Concepts

5.01 presents the new user with a bewildering array of new concepts, many of which are more familiar to a C programmer than to a Summer '87 user. It's easy to be put off and to rely on familiar techniques. Many developers have still not moved to 5.01 and of those who have, the majority are still writing Summer '87 code. This is a pity because 5.01 is not very good at compiling Summer '87 code and is in any case a far superior development language. The major concepts used in the code presented in this article are covered below. Figure 1 illustrates the pre-processor, including an example of a code block.

Pre-processor - A batch-driven 'search-and-replace' feature. Patterns to match and

```
//Include Nantucket definitions for fopen()/fcreate():

#include "fileio.ch"

/*
 #xcommand defines an extended user
 defined command which cannot
 be abbreviated to 4 characters:
   default cName to ""
 becomes:
  cName := iif(cName == NIL, "", cName)
*/
#xcommand DEFAULT <p> TO ;
          >                ;
         <p>:=iif(<p> == NIL,,<p>)

/*
 #xtranslate is similar to #xcommand
 but is commonly used where syntax will
 be "function-like". The code block
 illustrated has a parameter passed to
 it, cFile, which is assigned to the
 variable cF. cF is visible only within
 the code block. The block returns the
 result of evaluating the if() in this
 case a file handle.

 nHnd := OpenOrCreate("error.log")
Will produce:
 nHnd := eval({|cF|                ;
              if(file(cF),         ;
              fopen(cF, FO_READWRITE),;
               fcreate(cF, FC_NORMAL)} ;
              },"error.log")
*/

#xtranslate OpenOrCreate(<cFile>)    ;
      =>                             ;
      eval({|cF|                     ;
            if(file(cF),             ;
            fopen(cF, FO_READWRITE),;
            fcreate(cF, FC_NORMAL)} ;
           }, <cFile>)

/*
 #define is used for constants and
 volatile data. It is the only
 directive that IS case sensitive:
*/
#define BUFFSIZE 1024

// Sample code using the directives

function audittrail(cLog)

local nHnd,;
      cBuffer := space(BUFFSIZE)

default cLog to "audit.log"

nHnd := OpenOrCreate(cLog)

// Etc.

return NIL
```

Figure 1 - Example pre-processor directives including a code block.

replace are specified either at the top of the source file or in a separate #include file. Pattern matching is performed before the program is compiled. The pre-processor has three main uses; it can enhance program readability, it can separate volatile data from the rest of the system making changes easier, and it can hide complexity by mapping user defined commands onto function calls (all commands except flow-control commands in Clipper are mapped to function calls in STD.CH).

Code Blocks - A mechanism by which a variable can point to executable code. The code can be executed directly through one of 5.01's EVAL() functions or indirectly via an object's method. A Code Block is a little like a C pointer-to-function and can have parameters passed to it and return a value.

Multidimensional arrays - An array in 5.01 is more like an undeclared structure than the sort of arrays C programmers are used to: any element in any array can have any data type, including another array. Array names point to the array structure in a similar manner to the way pointers work in C, so the same array can be referenced by more than one variable, and references to arrays can be passed to and returned from functions without the array being copied.

TBrowse object - an instance of the TBrowse class that contains the data (instance variables) and code (methods) required to define and manipulate a browse table. A TBrowse object relies on one or more TBcolumn objects, each of which describes the formatting, display and contents of a single table column. There are two other fixed classes in 5.01 - Get objects are used to control data-input and an Error object is instantiated when a run-time error occurs.

Static and local scopes - A local variable is visible only within the function in which it is declared and is destroyed when the function returns. A static variable has local scope, but is retained after the function returns, coming back into scope when the function is called again. A file-wide static variable is declared outside a function and is visible to all functions within the same source (.PRG) file. A static function may only be called by functions declared within the same source file. These scopes facilitate encapsulation by allowing the developer to hide data more efficiently than the PUBLIC and PRIVATE scopes of Clipper '87.

The application

A common technique in database applications is to 'browse' a table of data. In its simplest form this involves displaying part or all of a DBF file, each field corresponding to a column in the table. The user can then cursor through the table to view the contents of the file. Clipper Summer '87 extended this concept with the DBEDIT() function, which allowed the developer to specify the contents and formatting of each column and passed control to a configurable key-handler whenever a key was pressed, making it possible to build an entire user-interface around a browse table.

```
#include "box.ch"
#include "inkey.ch"
function main()
local i       ,; // Array index
      oTB     ,; // Tbrowse object
      oTC     ,; // TB column object
      cFld    ,; // Field name
      bGSet   ,; // Field get/set block
      nKP := 0   // Code of key pressed
/*
 Open the file to browse &
 instantiate the TBrowse object:
*/
oTB := TBrowseDB(02, 10, 23, 70)
oTB:headSep:=chr(196)+chr(194)+chr(196)
oTB:colSep :=" " + chr(179) + " "
oTB:footSep:=chr(196)+chr(193)+chr(196)
use staff index empcode
/*
Instantiate a TBcolumn object for each
field & add it to the TBrowse object:
*/
for i := 1 to fcount()
/*
 fieldname(n) returns the name of field
 number n. fieldblock() returns a
 "get/set" code block for the field,
 which when EVALuated gets the value of
 the field & sets it to the new value
 if one has been passed.
*/
  cFld  := fieldname(i)
  bGSet := fieldblock(cFld)
  oTC   := TBcolumnNew(cFld, bGSet)
   oTB:addcolumn(oTC)
 next
 /*
 Set the screen up & then pass
 control to the key-handler:
 */
 cls
 @ 01, 09, 24, 71 box B_SINGLE
 do while (nKP := inkey()) != K_ESC
 /*
  oTB:stabilize works incrementally &
  can be interrupted by a keystroke, so
  you don't have to wait for the screen
  to redraw every time you press a key.
 */
  do while ((! oTB:stabilize())    ;
     .and. (nKp := inkey()) == 0)
  enddo
/*
  We used TBrowseDB() so these methods
  have been set up for us (this is just
  a sample):
 */
   do case
   case nKP == K_RIGHT;  oTB:right()
   case nKP == K_UP;     oTB:up()
   case nKP == K_LEFT;   oTB:left()
   case nKP == K_DOWN;   oTB:down()
   case nKP == K_HOME;   oTB:home()
   case nKP == K_PGDN;   oTB:pagedown()
   case nKP == K_END;    oTB:end()
   case nKP == K_PGUP;   oTB:pageup()
   endcase
 enddo
return NIL
```

Figure 2 - Basic TBrowse

5.01's browsing abilities are even more powerful, using an object-oriented approach to make every aspect of the browse configurable. A TBrowse object can be configured to browse anything, in any order, including arrays, DBF files and even binary files. Once configured, columns in the object can be frozen or hidden spreadsheet-style, re-sized, swapped or removed without exiting the browse. Each column can have its own colour scheme and individual cells or groups of cells can be coloured. Cells can even be coloured according to their content (negative numbers appear red, for example). The key-handler for a TBrowse object is also totally user definable (DBEDIT() used to intercept certain keys for its own use) and you can even set keys up to behave differently for each column in the table.

A TBrowse object is configured by changing its exported instances, which can also be interrogated. The ability to interrogate instances means the TBrowse object could be reconstructed from copies of its instances, which could be stored off-line and re-loaded when required. Following on from this, it should be possible to write a routine that allows a user to configure a TBrowse to his satisfaction and then to save it to a disk file, from which it could be reloaded. Such a routine could be included in shipped applications to allow power-users the flexibility to change their user interface or used as a productivity or prototyping tool by developers.

There is a catch (of course!) Neither Clipper objects nor code-blocks can be directly stored off-line, so some translation will be required.

Configuring a browse table

The steps involved in configuring and invoking a TBrowse are as follows:

Instantiate the TBrowse object with a call to TBrowseNew().

Initialise instance variables to control colour, heading and column separators etc.

Define and assign methods to control cursor movement etc.

Instantiate a column object for each column in the browse table.

Change the column's instance variables to control width etc, if the default is not acceptable.

Define and assign a method to control the data source for each column.

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Add the columns to the TBrowse object.

Stabilise the TBrowse object (which draws it on the screen).

Pass control to the key-handler (usually a CASE statement).

Most browse tables manipulate data from DBF files and TBrowseDB() is supplied to instantiate an object with default cursor movement methods for these.

Figure 2 illustrates the steps involved in setting up a basic browse for a DBF table.

Having configured the TBrowse object, our aim is to be able to save it to disk. Since we can't write the object to disk directly, we must find a way of saving its unique instances and methods so that we can reconstruct it by using them to configure a new object. Objects in 5.01 are physically implemented as structures which we can model using arrays.

Saving and restoring arrays

Clipper lacks functions to save and restore arrays to and from disk files, so we will need to write them. These will be useful additions to our armoury, not least because they can be used as alternatives to the 5.01 SAVE and RESTORE commands (which write/read variables to/from disk .MEM files), which only work with PUBLIC and PRIVATE variables.

Code for a save array function is illustrated in Figure 3. The disk file created has an offset table at the top with the data following it. Each array has an entry in the offset table with the array name and the offset into the file at which its data starts, measured from the start of its offset table entry.

As new arrays are added the file grows in both directions; the new offset table entry is inserted at the very top of the file and the data is appended to the bottom. This mechanism ensures that the offsets of existing arrays do not have to be adjusted when new arrays are added to the file.

Not all Clipper data types can be saved in this manner: references to code blocks are created at run-time and cannot be stored off-line. Fortunately 5.01 includes a means of compiling code blocks that have been created as strings ('stringified blocks') using the & symbol, which will allow us to save and retrieve a block as a string and compile it later.

Saving a TBrowse object

An object in Clipper 5.01 can be 'converted' to an array by adding an element to the array for every exported instance variable.

Methods are stored as stringified blocks and compiled to code blocks when the object is restored. Information external to the object that is required to recreate the browse table will also be stored in the array, including the names of the DBF and index files, the

```
#include "fileio.ch"
#include "inkey.ch"

function SaveArray(aArray, cName, cFile)

 local nHnd,; // File handle
       nOff,; // File offset of array
                cOff   // nOff as 4-byte int

// Open or create save file:
 nHnd := OpenOrCreate(cFile)
 if nHnd == F_ERROR
    qout("Can't open/create: " + cFile)
    return F_ERROR
 endif

// Calculate data offset:
 nOff := fseek(nHnd, 0, FS_END) + 16
 cOff := l2Bin(nOff)

// Add jump table entry:
 nHnd := AddOff(nHnd,cName,cOff,cFile)

// Convert array to string & append it:
 fwrite(nHnd, Arr2String(aArray))
 fclose(nHnd)

return 0

function AddOff(nHnd,cArr,cOff,cFile)

 local cBuf := space(512),;// Buffer
       nThn              ,;// Tmp file
       nByte               // Bytes read

// Create & open temporary file:
 nTnd := fcreate("TEMP", FC_NORMAL)

// Write offset table entry:
 fwrite(nTnd, padr(cArr, 12) + cOff

// Append the old file:
 fseek(nHnd, 0, FS_SET)
 do while (nByte := fread(nHnd, @cBuf,;
                          512) > 0)
    fwrite(nTHnd, cBuf, nByte)
 enddo

// Rename the new and re-open it:
 fclose(cTHnd)
 fclose(cHnd)
 ferase(cFile)
 frename("TEMP", cFile)
 nHnd := fopen(cFile, FO_READWRITE)
 fseek(hnd, 0, FS_END)
return nHnd
```

```
function Arr2String(aAr, cBuf)


 local nLen  ,; // Number of elements
       i     ,; // Array index
       cN    ,; // Number as a string
       cEtype,; // Element data type

/*
  cBuf is passed back by reference in
  recursions & needs to be initialised
  on the first call:
*/
 if cBuf == NIL
   cBuf := " "
 endif

/*
  Calculate number of elements in array
  & append type & length to buffer:
*/
 nLen := len(aAr)
 cBuf += valtype(aAr) + i2bin(nLen)


/*
  If the element is an array, recurse
  Otherwise, append its data type, then
  append its length & data if it is a
  simple data type (C, N, D or L).
*/

for i := 1 to nLen
 cEtype := valtype(aAr[i])
 if cEtype $ "AO"
   Arr2String(aAr[i], @cBuf)
 else
   cBuf += cEtype
   do case
   case cEtype == "N"
     tmp := ltrim(str(aAr[i]))
     cBuf += i2bin(len(tmp)) + tmp
   case cEtype == "C"
     cBuf += i2bin(len(aAr[i])) + aAr[i]
   case cEtype == "D"
     cBuf += dtoc(aAr[i])
   case cEtype == "L"
     cBuf += iif(aAr[i], "T", "L")
   endcase
 endif
next

return cBuf
```

Figure 3 - Saving a multidimensional array

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type of box that surrounds the table and the key-handler.

In the key-handler in Figure 2, a `CASE` statement is used to determine the code run when a key is pressed. In Clipper, each key has an 'inkey' value - the integer returned by the `inkey()` function when that key is pressed. Inkey values can be positive or negative; for example the inkey value of the F10 key is -9, the value of the RETURN key is 13. We could write a more flexible version of the key handler by creating a two-dimensional array of code blocks, the first dimension representing positive inkey values and the second negative values.

When a key is pressed we look it up in the array and evaluate the appropriate code block. If we need to change the action of an existing key, or define a new key to perform a new action we can construct a code block and assign it to the appropriate element in the array - the key handler will do the rest.

To go one step further, we could store stringified blocks in the array instead of blocks; that way we could store the key handler methods off-line with the object.

In recognition of the need for an object to be able to carry around more than the pre-defined instances and methods, Nantucket has provided each class with a cargo slot that can have any data type written to it. The cargo may hold simple data, a code block, another object or even a multi-dimensional array.

Figure 4 shows code that illustrates the new key handler and the use of the cargo slot to store miscellaneous data. The key handler methods array contains stringified code blocks which are 'compiled' within the key handler. In a 'production' version the contents of the array would be pre-compiled outside the key handler for speed.

In the case of a `TBrowseDB` object we can accept the default cursor movement methods created for us when we re-instantiate the object for the DBF concerned - we do not need to save them in the array. The code block that determines the contents of each column is another matter; we do need to save a stringified version of this, for which we can use the cargo slot in the `TBcolumn` in question.

It is now possible to write a pair of conversion functions that map a `TBrowse` object to an array and vice-versa. The array produced contains only simple data types and can be safely saved and restored to and from a disk file.

User configurable TBrowse

With the ability to store and retrieve `TBrowse` objects off-line instead of having to write code to recreate them afresh each time, we can realistically tackle a program to let users configure and save their own browse tables. With a little extra effort we might even be able to extend the concept to provide a powerful development tool - after all, methods can be implemented using stringified blocks, strings can be entered with a text editor and the syntax rules for code blocks are fairly straightforward...

The key handler methods array can be extended to include a second dimension for function keys, which can evaluate code blocks that manipulate the browse table itself. For example, a function can be written to allow the user to re-size and/or move the browse table on the screen. The function can be 'attached' to a function key by assigning an appropriate stringified block to the correct element in the methods array. As the user moves the table the appropriate instance variables are updated so that when the browse is saved the new co-ordinates are saved with it.

By building on these concepts, a dynamically configurable browse table can be constructed that allows the user to change almost anything, including the number, contents, titles, formatting and order of columns. With a little extra work an editor for changing stringified blocks can be devised and the key handler methods array updated on-line.

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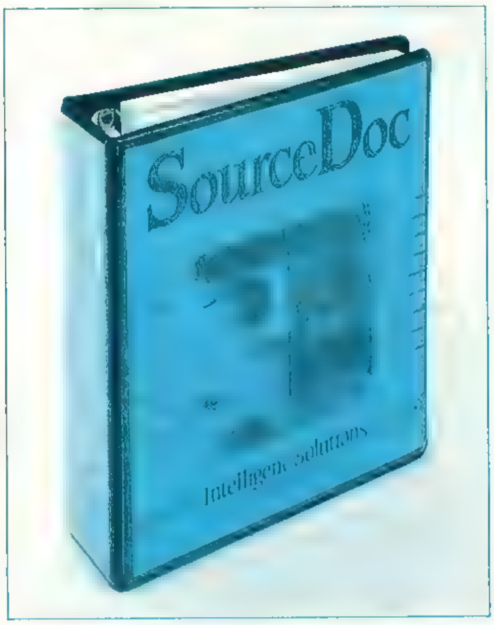

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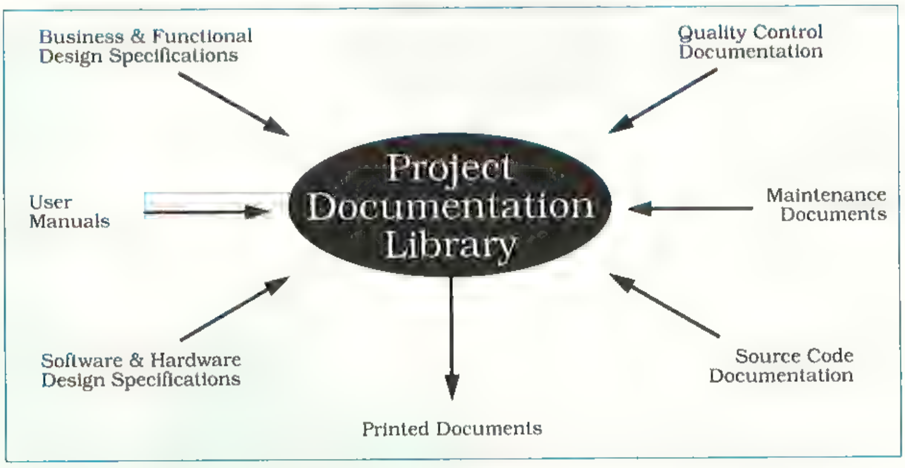
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Conclusion

Familiarity with all of Clipper 5.01's features and a modular approach to development can lead to a very high degree of reusability.

The concepts behind the code presented here can be applied to construct a set of tools that the developer, or even the end-user, can use to build an application. Applications built in this manner are easily maintainable and can be enhanced or extended easily. In addition, the quality of a system built out of tried and tested components is much higher, reducing maintenance overheads. The price, of course, is increased up-front development. There is often an overhead involved in modular design; do you hard code the report or write an *ad-hoc* report generator? Commercial reality usually prevents increasing the cost of the current development to save on future systems, and code is continuously rewritten from system to system.

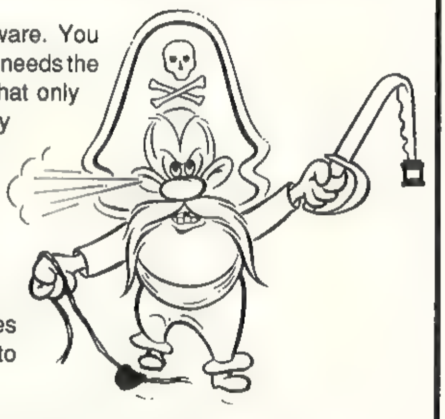
Perhaps the greatest single advantage of OOP is that it forces the developer to adopt a modular approach, but you have the option to adopt this approach anyway, you don't have to wait for OOP.

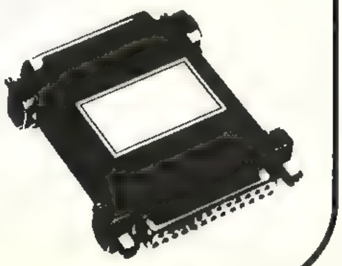
EXE

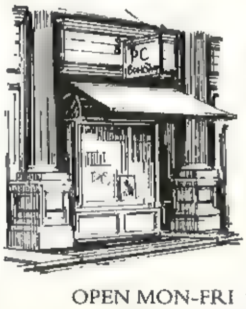
```
#include "inkey.ch"
#include "box.ch"

// tbo:cargo array contents:
#define TB_DBF   1  // .DBF File name
#define TB_NTX   2  // .NTX File name
#define TB_BOX   3  // Box characters
#define TB_METH  4  // Methods array
#define TB_SLOT  5  // Free slot

function aNewTbo(cDbf, cNtx)

 local i,;            // Array index
       oTb,;         // Tbrowse object
       aMethods,;     // Methods array
       cField,;       // Field name
       nKp            // Key pressed

 use (cDbf) index (cNtx)
 oTb := tbrowsedb(02, 10, 23, 70)

// Initialise methods array:
 aMethods := methods()

// Set up cargo slot to save info:
 oTb:cargo := array(TB_SLOT)
 oTb:cargo[TB FILE]  := cDbf
 oTb:cargo[TB_INDEX] := cNtx
 oTb:cargo[TB BOX]   : = B_SINGLE
 oTb:cargo[TB_METH]  := aMethods
 oTb:cargo[TB_SLOT]  := NIL

 for i := 1 to fcount()
   cField := fieldname(i)
    oTb:addcolumn(tbcolumnnew(cField,;
                     fieldblock(cField)))
  next

  cls
  @ 01, 09, 24, 71 box oTb:cargo[TB_BOX]
  do while (nKp := inkey()) <> K_ESC
    do while ((! oTB:stabilize())    ;
       .and. (nKp := inkey()) == 0)
    enddo
    if nKp < len(aMethods) .and. nKp > 0
      if valtype(aMethods[nKp]) == "C"
        eval(&(aMethods[nKp]), oTB)
      endif
    endif
  enddo

return NIL

function methods()

// Key array is of stringified blocks
// so it can be saved to a disk file:

  local aMet[40]

  aMet[K RIGHT]  := "{|b| b:right()}"
  aMet[K_LEFT]   := "{|b| b:left()}"
  aMet[K_UP]     := "{|b| b:up()}"
  aMet[K_DOWN]   := "{|b| b:down()}"
  aMet[K_PGDN]   := "{|b| b:pagedown()}"
  aMet[K_PGUP]   := "{|b| b:pageup()}"

return aMet
```

Figure 4 - Key handler with methods array

James Ormrod is a founder member of Applications Technology Ltd, a Nantucket Authorised Training and Development Centre. He is actively developing in 5.01 and wishes somebody would properly document the C and Assembler Extend System. ApT can be contacted on (0491) 26060.







Nantucket Tools II

The Clipper world is particularly rich in third party add-ons. However, Bob Rimmington has been looking at a new library from Nantucket itself.

The main contenders in the xBASE market have their particular merits and their protagonists. However it is not always sufficient to compare basic packages, as the extent to which a system can be supplemented and enhanced with supporting software may be more relevant. Clipper is especially strong in this respect, with a wide range of add-on packages. Now Nantucket, the company behind Clipper, has itself released a much extended toolkit function library.

Over 560 functions are provided. The types and numbers per category are set out in Figure 1. The toolkit is aimed squarely at Clipper v5.01, although most functions are said to work with the Summer '87 version as well. They are all included in a single .LIB file though some categories also require a supplied Extended Driver .OBJ file to be linked in. Various documentation, examples, font designer and other supporting files are also included. Installation is similar to Clipper itself, decompressing from the three (720 KB) distribution floppies onto the hard disc.

New Categories

Four categories are completely new to Tools II. For networks, just seven functions apply to PC LAN/MS-NET products, the remaining 37 to Novell. All of the latter support Netware 2.1 upwards and ELS II but not necessarily earlier versions or ELS I. The possible implementations are clearly indicated for each function. If you know your Novell you can access it via the Clipper RUN command, but Tools II not only makes things much easier but allows return values to be used and tested. LOGIN information such as IDs, rights and privileges can be obtained. Files can be copied and purged, the maximum and the free capacity of a Volume can be pre-checked in respect of both files and space. For printing, the Novell CAPTURE mode can be set, tested, activated and deactivated. Just one example, `NNETCAPSSF(1, FALSE, TRUE, 0, 5, 8, 2)` will specify device LPT1, set an end-of-run form feed, print banner page, select server printer No. 0, set a five second time out, set tab width to 8 and print two copies.

The second new category, maths, contains a mixture of trigonometric and financial functions. A third, Peek/Poke, enables direct reading and writing of bytes and 16-bit words to memory and designated ports. It is rightly accompanied by dire warnings of use by anyone who does not fully understand the possible consequences.

Tools II was originally written in German, and the translation to English has resulted in a few quirks. Not the grammar or style of any text, that is fine, but rather the occasional nonsense. For example, the introduction to the fourth new category, Get/Read functions, says it has been 'retained' for the sake of compatibility. `GETFIELDCOL()` and `GETFIELDROW()` return the column and row start positions of a `GET`, useful if you need to write to that position from a VALID UDF function. There is a `GETSECRET()` function that substitutes asterisks (*) for characters actually entered. Finally four functions for saving current `GET`s and `SET KEY..TO` settings to arrays and for restoring them. These enable new `GET` masks or key settings to be activated without losing the current ones.

Windows and Extended Drivers

The category that will first attract most new users is that for Windows. Let us get one thing straight from the start, this has nothing at all to do with Microsoft Windows. Instead it is a facility to place normal Clipper input/output in screen 'Windows' that can be moved, re-sized and overlapped by either the programmer or the user. For the latter, SCROLL LOCK must be activated and then the cursor keys act as one might expect. There is no Mouse option though this may be possible through one of the third party add-ons.

At the simplest level, the windows functions do little more than could be achieved by saving a screen area, writing to it and then restoring. However they do automatically replace both the content and colour attributes of all areas overwritten. The first plus comes with the positioning of output with `@ SAY` and similar statements. The coördinates apply to the window, **not** the screen. So a window can be repositioned to suit a client with no more than a change to the `WOPEN()` parameters. The second comes with the ability to alternate between up to 255 windows (memory permitting) and to write to the currently selected window.

Extended Driver functions in part support Windows operations, in part act on a normal screen. `DSETWINDOW()` enables the output of any external programs, such as DOS, to be confined to the current window. It is possible to address a virtual screen of up to 255 columns or 255 rows. There is a 32 KB memory limit, so a typical maximum combination would be 255 columns and

FUNCTION CATEGORIES AND NUMBERS	
Windows	22
Extended Drivers	51
Serial Communications	40
String Manipulations	88
Peek/Poke	9
Number/Bit Manipulations	28
Video	60
Disk Utilities	50
Printer	15
Date and Time	27
Miscellaneous	22
Database	7
Set Status	44
Network	44

Figure 1 - Functions by Category

Q.

"What will happen to dBASE?"

"When can I compile my dBASE code?"

"Will I have to learn Paradox?"

"How can I learn OOP at my own pace?"

"What will the next version of dBASE be like?"

"Will I have to learn another language?"

"Where's the professional compiler?"

"X" what?"

"Will there be a next version of dBASE?"

nantucket

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CIRCLE NO. 449

128 rows. The screen then becomes a view into a far larger area. The size of a virtual screen is defined with SETMAXCOL() and SETMAXROW() functions. For xBASE programmers, after years of working to a limit of 25 rows and 80 columns, it seems uncanny to be able to put @ 111,222 SAY ... etc into a program. It does work though. An immediate use for this is where a normal entry screen is just not able to accommodate all the required GETs but paging to second or third screens is not ideal. The GETs just scroll up as those at the foot of the screen are entered, the up-cursor will bring back those at the top. Simple to program, simple to use. See Figure 2.

DSETQFILE() enables the writing of a 'Quit' file, comprising the current keyboard buffer, on any form of exit. An ideal way of checking for a normal exit or tracing the cause of a program failure. EGA43(), VGA(28) and VGA(50) allow alternative screen modes. GETKXCLAT(), GETKXTAB(), INKEYTRAP(), SETKXLAT(), SETKXTAB(), TRAPANYKEY() and TRAPSHIFT() allow sophisticated key trapping and action. INKEY() will never be the same again. KEYSEND() and KEYREAD() extend the use of the keyboard buffer.

External Devices

The Serial Communications category will not excite every Clipper developer but could prove invaluable to some. Among new functions for Tools II are XMOBLOCK() and XMOCHECK(), to generate and test X-MODEM blocks. For printing there are functions to check ports and printers, print the screen (very handy when logging application errors) and make various use of the DOS PRINT facility.

Many applications require access to drives or to do more than USE and INDEX files within the normal xBASE language. Such activities work through DOS and so make the application vulnerable to normally untrappable DOS errors. This can be a particular problem where the operator has to use a floppy drive for backup or similar tasks. The scope of the Disk Utilities category is now so wide that it is difficult to think of a circumstance it does not cover. DISKREADY() will check that a drive contains a disk and is ready to use. DISKREADYW() will check that it is not write protected. DISKFORMAT() will allow, through UDFs, both easier selection of format modes and control of format track repeats. Other functions allow interrogation and control of available disk space in relation to file sizes.

A complete sequential backup using a set of disks is possible with safety checks at every stage. FILESEEK() can be called with parameters to find the first matching file, then repeatedly called without parameters to find each subsequent file. Any developer who has found the combination of users and floppy disks a potential hazard would find this category alone well worth the money.

```
/* NANTUCKET TOOLS II  -  EXAMPLE CODE

   The code below illustrates Tools functions for
   Windows and for a Virtual Screen.  Both require the
   Extended Driver file NT2US50.OBJ to be linked in.
*/

#include 'INKEY.CH'              //... Include constants for key
codes
#define TRUE    .T.
#define FALSE   .F.

LOCAL nWinNum1,nWinNum2,nWinNum3,nKey:=0,nCtr

/* Open three Windows.  Write text to them.  Select,
   move and close Windows.  Pause using INKEY(0)
*/

CLS
@ 12,30 SAY 'This is normal screen'
*
WSETSHADOW('W/BG')               //... Transparent shadows
nWinNum1=WOPEN(5,5,15,50)        //... Open first window
WBOX()                           //... Draw default box round it
@ 2,2 SAY 'This is Window No. 1'
INKEY(0)
nWinNum2=WOPEN(10,25,20,60)      //... Open second window
WBOX()
@ 2,2 SAY 'This is Window No. 2'
INKEY(0)
nWinNum3=WOPEN(15,35,22,75)      //... Open third window
WBOX()
/.... Position text relative to border
@ WFROW(TRUE)+1,WFCOL(TRUE)+1 SAY 'This is Window No. 3'
INKEY(0)
//... Select first window, this brings it to the top
WSELECT(nWinNum1)
INKEY(0)
WMOVE(WROW()-3,WCOL()-3)         //... Move up and to left
@ 4,2 SAY 'Now moved towards top left'
INKEY(0)
WCENTER(TRUE)                    //... Move to centre of screen
@ 6,2 SAY 'Now centred on screen'
INKEY(0)
*
WCLOSE()                         //... Close current window (1)
INKEY(0)
WCLOSE()                         //... Close current window (3)
INKEY(0)
WCLOSE()                         //... Close remaining window (2)
INKEY(0)

/* Now back to normal screen with original text restored */

/* Define virtual screen, write text to right of and below
   physical screen.  Move about virtual screen with cursor keys
   in conjunction with INKEY(), DO WHILE loop and DO CASE test.
   If GETs are used, normal navigation with cursor keys causes
   physical screen to show relevant portion of virtual screen
*/

SETMAXCOL(121)                   //... Set number of columns
SETMAXROW(51)                    //... Set number of rows
*
@ 0,0 CLEAR TO 51,121            //... Clear (text etc. may remain
                                 //...   in unseen screen area)
@ 3,1 SAY 'Left of screen'       //... Write across virtual screen
@ 3,35 SAY 'From column 35'
@ 3,65 SAY 'From column 65'
@ 3,99 SAY 'From column 99'
*
FOR nCtr=5 TO 51 STEP 2          //... Write down virtual screen
  @ nCtr,5 SAY 'This is row '+NTOC(nCtr)
NEXT
*
@ 0,0 SAY ' '                    //... Return to top left
*
DO WHILE nKey !=27               //... Loop until Esc pressed
  *
  nKey:=INKEY(0)                 //... Read cursor keys with
INKEY()
  *
  DO CASE
  CASE nKey=K_UP
    FIRSTROW(FIRSTROW()-1)       //... Reset first row of screen
  CASE nKey=K_DOWN
    FIRSTROW(FIRSTROW()+1)
  CASE nKey=K_PGUP
    FIRSTROW(FIRSTROW()-10)
  CASE nKey=K_PGDN
    FIRSTROW(FIRSTROW()+10)
  CASE nKey=K_LEFT
    FIRSTCOL(FIRSTCOL()-1)       //... Reset first column of screen
  CASE nKey=K_RIGHT
    FIRSTCOL(FIRSTCOL()+1)
  CASE nKey=K_CTRL_LEFT
    FIRSTCOL(FIRSTCOL()-10)
  CASE nKey=K_CTRL_RIGHT
    FIRSTCOL(FIRSTCOL()+10)
  CASE nKey=K_ESC
    EXIT
  ENDCASE
  *
ENDDO
*
@ 0,0 CLEAR TO 51,121            //... Erase everything
FIRSTCOL(0)                      //... Reset for normal physical
screen
FIRSTROW(0)
*
RETURN

/*   EOF Demo program   */
```

Figure 2 - Example code for Windows and Virtual Screens

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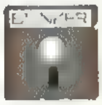

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CIRCLE NO. 451

Strings and Numbers

Attempting to illustrate the many string functions risks becoming just a boring catalogue. Some seem quite obscure at first, then a need arises and their value is appreciated. `REMALL()`, `REMLEFT()` and `REMRIGHT()` are like `ALLTRIM()`, `LTRIM()` and `RTRIM()` except that instead of just blanks any specified characters can be removed. Ever needed to remove trailing '0's from a number? Try

```
REMRIGHT(cMemvar,'0')
```

Many other functions allow selection and manipulation of characters within strings. `CHARSORT()` allows sets of characters to be sorted within a string with parameters to set the length of the sorting element, offsets and other options.

Three functions enhance the use of others. `CSETREF()`, if called with `TRUE`, suppresses a return value. When used with a long string passed by reference it avoids wastage of memory on a duplicate string. `CSETATMUPA()`, if called with `TRUE`, sets a multi-pass mode on for functions such as `ATREPL()` (search for a sequence within a string and replace it) and `NUMAT()` (count the occurrences of a sequence in a string). `SETATLIKE()` enables wildcards to be used in `AT...()` and similar functions.

A group of 'Token' functions can be used to identify words, sentences, dates and other sets of characters within a string. A 'Token' is a sequence of characters within delimiters. These could be spaces and all the normal punctuation symbols to identify words. In this context a word could have a different delimiter at each end such as a space before and a comma after). Typical uses for the token functions include neat word-wrapping of long text fields in a report and fast text searches. For the latter, words in a text field could be extracted, saved (with a record ID) in a separate indexed file and then found with the `SEEK` command.

The Number/Bit category allows conversion of numbers to a different base and various binary operations such as `AND`, `OR`, `XOR` and `NOT`. Other functions include two for random numbers and another to convert floating point numbers to 8-byte strings.

Other Categories

A further 184 functions are in the six categories not already mentioned. Space permits mention of only a few samples. `NTOCDOW()` and `NTOCMONTH()` change week and month numbers into names. `SHOWKEY()` enables screen display of the status of the NUM-LOCK, SCROLL-LOCK, CAPS-LOCK and INSERT keys. `ENVPARAM()` reads the DOS environment into a string.

If you find the combination of users and floppy disks a hazard, then these functions are well worth the money

The Video category include alternate fonts and palettes while Miscellaneous includes sound. Some example files are supplied for the latter. For the client who has everything, how about a message in Cyrillic script as the screen slowly fades from one shade to another? Or a computer rendition of the Moonlight Sonata in the background? Perhaps not but, if he does insist, it is now possible. `SCREENWRITE()` writes a screen to a file, `FILESCREEN()` will read it back again. Functions such as `CLEARSLOW()` and `SAYMOVEIN()` allow visual effects, similarly `GETBOXGROW()` for a controlled box explosion.

Documentation

The toolkit in part extends the scope of Clipper itself, in part provides an off-the-shelf and faster alternative to routines a programmer could write for himself. If the potential saving in development time is to be realised good documentation is essential. Nantucket scores high marks with its main reference material. Every function is fully described, with brief examples, in a set of three clear, ring-bound manuals. The same information is repeated in a data file for use with the Norton Engine supplied with Clipper itself. The latter is good providing you know the relevant category, as this must be selected first. It is a pity that no overall search facility is included for those occasions where the precise syntax for a known function name is required.

Unusually, what seems to be the same data is supplied in a third format in a text retrieval system. This will search for all entered strings, including wild cards. Although I commend Nantucket's intentions, I have to confess that I have found it of little value. It is not a TSR and so is not easily accessed while writing code. Nor does it tell me anything fresh. Sorry Nantucket, perhaps the penny will suddenly drop one day. A surprising omission is any instruction on how to start it though few will fail to try the obvious solution of just entering the name of the .EXE file.

Less satisfactory is the limited provision of 'how to use it all' guidance. There are some example program files, enough to prove how valuable these can be, too few to cover most functions. Query By Example is very much flavour of the month for users, why not Program By Example for developers? Many would find this more beneficial than three versions of the formal instructions. The example programs include only minimal and often inadequate comment. Not all use the current Nantucket convention for naming variables. Except for the examples, no source code is supplied.

Performance

All the functions tried worked without problem. Tools II includes a 'two screen' Debug facility for those with both VGA and Hercules cards in their machines and of course the corresponding monitors. It was not possible to try this (the /S switch used with CLD gives a comparable facility on one screen using the 50 line VGA mode) but with several functions calling the debugger did seem to cause some problems. Use of Blinker in place of RTLINK seemed ok, but only if the Tools II .LIB and .OBJ files were not placed in the overlay area.

Conclusion

Many of the Tools II functions open up areas not previously accessible to Clipper developers. With others, users will save much of the time spent building their own personal library. For the latter purpose alone saving just two days would make it self-financing. Few will find a need for all 565 functions. However it is the benefit from those that are used that matters. The Toolkit is comprehensive, well presented and, notwithstanding the small reservations, is well documented. It is the availability of additional products of this quality that help make Clipper the preferred choice of many xBASE developers.

EXE

Bob Rimmington is an independent xBASE and Clipper consultant. He can be contacted through Stanford Systems on 0444 236352. Nantucket Tools II is priced at £495. Nantucket is on 0707 373600.

Using Pre-Link Libraries

Interested in linking your applications more quickly and decreasing your disk space usage? Aric Rosenbaum explains how Clipper's PLLs can accomplish all of this and more.

With the introduction of Pocket Soft's .RTLink, a new method of linking has arrived on the Clipper scene. More specifically, we are talking about run time or pre-link libraries. Since Nantucket includes a copy of .RTLink with every copy of Clipper 5.0, this feature is available to every 5.0 user. This article will explain what pre-link libraries are and why they should be used. In addition, the usage and creation of pre-link libraries will be explored.

Background

Pre-link libraries (PLLs) provide a core of routines that are common to various different applications. They do not need to be compiled and linked every time an application is created. In addition, all of your Clipper programs can rely on one pre-link library. This significantly reduces link times, disk space, and modem transfer times.

For instance, it is almost a certainty that every one of your Clipper applications has a function that will centre a string on the screen. This is one of the many dozens of functions that developers think nothing about including in an executable. However, every time you create a new version of your program, you must compile and link the centre function. If you are truly organised and have placed the centre function in a library, you only need to deal with the time consuming linking. This is wasteful. Why not compile and link the function once? The code does not change. In addition, this code could be used as part of a common code bank for all your applications.

Pre-link libraries do just this. Instead of linking all you routines into a giant .EXE file (of the type for which Clipper is justly notorious), you create a smaller .EXE and supply a separate .PLL file. When your program is run, special code loads up the .PLL so that it can use the library functions. The reduction in disk space is achieved by having several applications share the same PLL.

Using .RTLink, you instruct the linker to create your own pre-link library. When linking an application, you inform the linker that you will be using a pre-link library. When the application is executed, the program will load and use the pre-link library.

Benefits

As I have hinted, the benefits of PLLs are substantial. They include decreased link times, decreased disk space and decreased modem transfer times. To illustrate the above three conclusions, two applications were tested. The first is a very short program that uses some of Clipper's features. This program, shown in Figure 1, utilises commands and features such as: `SKIP`, `eof()`, `SAY`, and `GET`. Using a one line program that says, 'Hello World' does not properly convey why Clipper is used. Since real life applications rarely work like test programs, I also compare a Summer '87 program that was recently converted to 5.0. In summary, linking times were as much as 4.8 times faster and applications were as much as 32.8 times smaller. Imagine a Clipper .EXE file that takes up as little as 7168 bytes of disk space! However, please note that I did not say that the executable was 7 KB. The executable still requires a 277 KB PLL.

If your clients are supported by modems and you routinely transfer new versions, these small executables are of interest. For example, instead of spending 16 minutes transferring an executable with a modem, you could spend 30 seconds. This enhances your ability to get your client back on-line as quickly as possible and keeps your money out of the telephone company's pockets.

Now, after all these fantastic claims, I am sure a few cynics exist. You might be saying, 'Oh sure. And do I get a free pair of Ginsui steak knives.' Well, I cannot promise the steak knives, but the claims are true. Figures 2 and 3 show the results for the small test program.

These are pretty impressive numbers. All of this with the pre-link library that ships with Clipper 5.0. This pre-link library includes CLIPPER.LIB, EXTEND.LIB, TERMINAL.LIB and DBFNTX.LIB. While the raw results for the real-life applications are not as awe-inspiring, they are still very credible. These results can be seen in Figures 4 and 5.

Again, the above numbers are based upon using Nantucket's BASE50.PLL pre-link library. By pre-linking the common libraries that I normally use, even better results can be obtained.

```
CLOSE DATABASES
CLEAR SCREEN
USE test_dbf INDEX test_ntx ALIAS test NEW
GO TOP

DO WHILE .not. eof()
   SKIP
ENDDO

sample := space(10)
@ 10,10 SAY 'Anything: ' GET sample VALID (.t.)
READ

? sample

RETURN
```

Figure 1 - Source code for small test program

Drawbacks

As everything else in this world, there are drawbacks to using pre-link libraries. These problems, however, are minimal. The first disadvantage is that using pre-link libraries creates a larger load module. The size difference varies with each application but is somewhere between 6 KB and 13 KB. With the introduction of VMM and dynamic overlays, this small overhead does not present a problem.

The second obstacle is more of a problem of logistics. What if the user, running Xtree after a heavy night on the glue, deletes the pre-link library? He will not only lose the application in the current directory but all the Clipper applications. This is regarded as the biggest detriment to pre-link libraries. For this reason, developers are leery of having multiple applications rely on one core. I, however, do not see this as a significant risk If you are really windy, marking the file as read-only

```
ATTRIB +r MY_PLL.PLL
```

will thwart all but the most determinedly suicidal users.

Using PLLs

Using pre-link libraries with your executable is so easy that I considered omitting this section. Nothing special needs to be added or changed in your executable. In addition, no special driver or TSR needs to be loaded before loading your application. When the linker links your application, it will properly inform the executable that it needs a pre-link library.

When executing an application that requires a pre-link library, the program will look in one of two places for the library. The first, of course, is the current directory. If a pre-link library is specific to a particular application or only one Clipper application exists in the system, the library will probably be placed in the same directory as the executable. However, if multiple applications are using the same pre-link library and these applications reside in distinct directories, a different approach needs to be taken. One approach is to place each application in its own directory and locate the pre-link library in a unique directory. When an application is executed it will load the pre-link library from the other directory. To do this, you have to tell Clipper where the pre-link library resides. This is done with an environment variable:

```
SET PLL=C:\PLL
```

The above environment variable will tell the application to search the PLL subdirectory on the C: drive if the proper pre-link library cannot be found in the current directory. If your pre-link libraries reside in different places, you specify the locations and separate them with a semicolon.

	w/ BASE50.PLL	w/o PLL
Size of TEST.EXE:	7,168	235,520
Size of BASE50.PLL:	277,504	n/a
Link time:	20.9 sec.	96.0 sec.
Transfer time with a 2400 baud modem:	30 sec.	984 sec.

Figure 2 - Raw results for the small test program

TEST.EXE	32.9 times smaller
Link time	4.8 times faster
2400 baud modem time	32.9 times faster (and less expensive)

Figure 3 - Comparative results for the small test program

	w/ BASE50.PLL	w/o PLL
Size of REAL.EXE:	105,472	343,040
Size of BASE50.PLL:	277,504	n/a
Link time:	67.1 sec.	159.1 sec.
Transfer time with a 2400 baud modem:	7.3 min.	23.8 min.

Figure 4 - Raw results for the real-life application

Linking with PLLs

If you are planning to use a pre-link library with your application, you must inform the linker and tell it what pre-link library will be used. To inform the linker that pre-link libraries will be used, a command is inserted in the link script file (ie .LNK file). If you are using the command line mode, you will need to use the '/PLL' switch. If this command is not included, the linker will either link the normal library or complain about undefined symbols. It depends on what is missing. If the pre-link library is not specified, the linker will automatically link CLIPPER.LIB, EXTEND.LIB, TERMINAL.LIB and DBFNTX.LIB. However, if the pre-link library is not specified and the required function is custom, the linker will issue an undefined symbols warning.

Specifying the pre-link library can be done in one of two ways. The first and most common is in the link script file. For example, when linking the test program, I used the following link script file:

```
FILE TEST
PLL BASE50
```

Alternatively, if I issued the link command from the DOS prompt:

```
RTLINK FILE TEST /PLL:BASE50
```

It really is no more difficult than including a normal library.

Creating PLLs

Creating pre-link libraries, while more difficult, is almost as easy as using them. In summary, it requires:

- Informing the linker that you are creating a pre-link library.
- Specifying the object files and libraries to search.
- Referencing the modules that are to be included.

The first step is accomplished by including the command word 'PRELINK' in your link script file. When the linker parses the script file, it will know that it should create a pre-link library instead of an executable.

The second step is the same as the normal linking process. Specify the object code files and libraries that should be used to construct the pre-link library. For example, if we are using the following to build our pre-link library:

Object files	Libraries
APP_OBJ1	COMM_LIB
APP_OBJ2	MOUS_LIB
APP_OBJ3	SCR_LIB

The link script file would look as follows:

```
PRELINK
OUTPUT MY_PLL

FILE APP_OBJ1, APP_OBJ2, APP_OBJ3
LIB COMM_LIB, MOUS_LIB, SCR_LIB
```

LOOK at all OPTIONS.

Software Protection - but which TYPE ?

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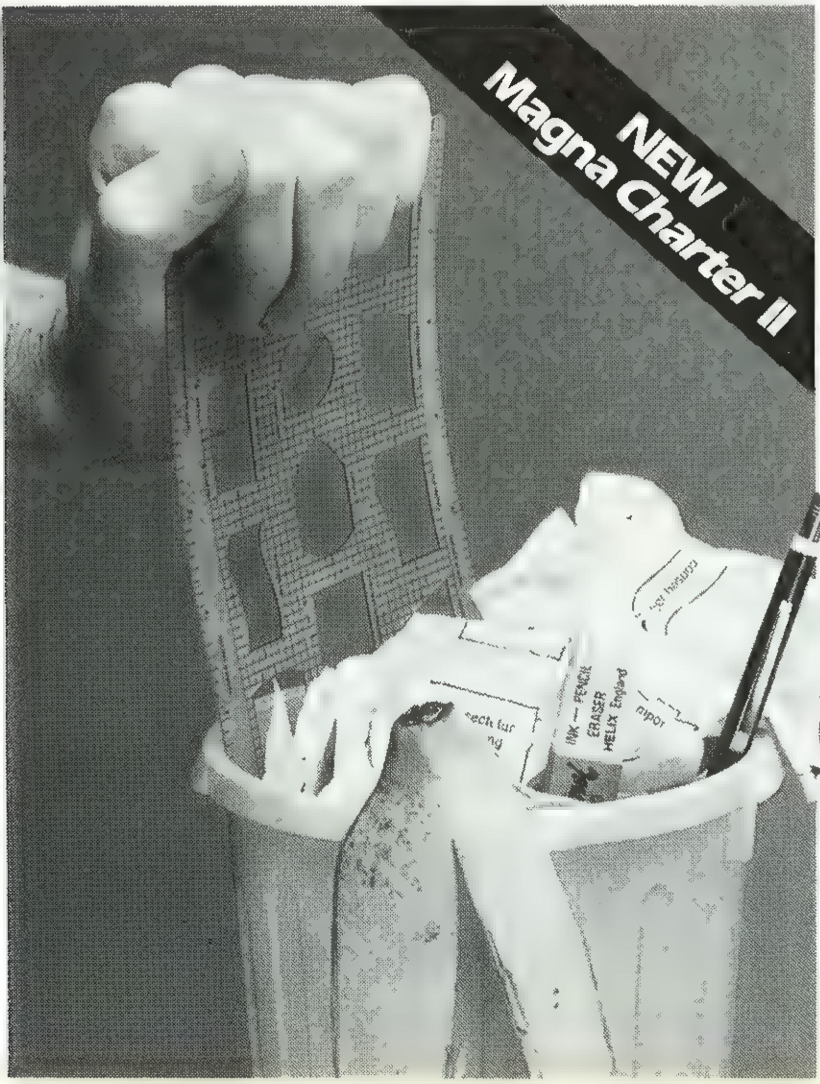
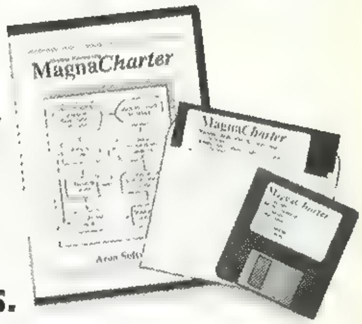


Out with the Old In with the New



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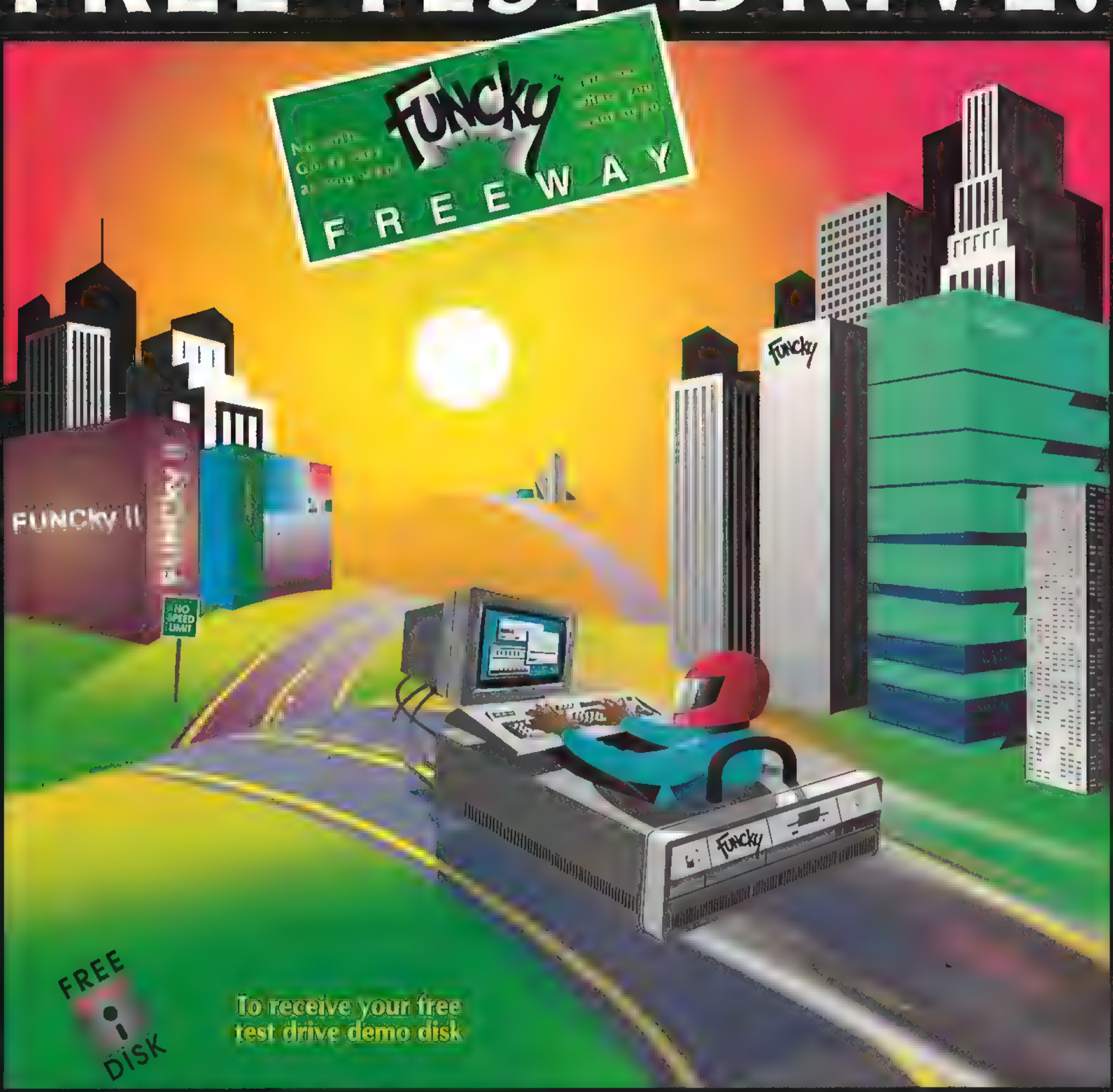

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It is important to note that the object code files that are listed contain common functions and procedures that we want to include in our pre-link library. You do not list all the object code files that make up your application.

An excellent way to illustrate the creation of a pre-link library is with a short analogy. Picture walking into a room full of books. You walk up to a stately oak table and sit down. Sitting in front of you is a completely empty table. Your project is to create a compilation of chapters from numerous books. Your first step of course is to get the books you need (object code files and libraries) and place them on the table in front of you. This done, you must now tell your assistant (linker) what chapters to include in the compilation. You do this by referring to the chapters (modules) in question. Once referenced, your assistant will dutifully copy the needed chapters into the compilation. After a minute or two (your assistant was a speedy, scholarly monk in a previous life), your compilation is complete and ready to be used by anyone who pleases.

Now that we have specified the object code files and libraries to search, we need to tell the linker what modules to place in the pre-link library. This is done with the `REFER` command. Following the `REFER` command are all the modules that should be included in the pre-link library. In our example COMM_LIB contains the following modules:

```
dial()
set_baud()
set_parity()
xfr_kermit()
xfr_x()
xfr_z()
```

We only want to include `dial()` and `set_baud()` in our pre-link library. We can do this by adding the following lines to our link script file:

```
REFER DIAL SET_BAUD
```

The link script file now looks as follows:

```
PRELINK
OUTPUT MY_PLL

FILE APP_OBJ1, APP_OBJ2, APP_OBJ3
LIB COMM_LIB, MOUS_LIB, SCR_LIB
REFER DIAL SET_BAUD
```

Based upon the above link script file, MY_PLL.PLL will contain two modules: `dial` and `set_baud`. Although we instructed it to search three object code files and two other libraries, only two modules were included. To include the modules in the other libraries, we would need to reference them.

One last note is that you should not worry about undefined symbols when creating a pre-link library. This is only a warning message. The undefined symbols will normally be resolved when the executable is linked. If, however, you receive an undefined symbols warning when linking the application then it is possible that the pre-link library was not properly created.

Real.exe	3.3 times smaller
Link time	2.4 times faster
2400 baud modem time	3.3 times faster

Figure 5 - Comparative results for the real-life application

```
PRELINK
OUTPUT BASE50

LIB CLIPPER, EXTEND, TERMINAL, DBFNTX
REFER _main
REFER _VOPS, _VMACRO, _VDB, _VDBF, _VDBFNTX
REFER _VTERM, _VPICT, _VGETSYS
REFER _VDBG
```

Figure 6 - BASE50.PLL link script file

```
PRELINK
OUTPUT MY_PLL

LIB CLIPPER, EXTEND, TERMINAL, DBFNTX
LIBRARY COMM_LIB MOUS_LIB SCR_LIB
FILE APP_OBJ1 APP_OBJ2 APP_OBJ3
REFER _main
REFER _VOPS, _VMACRO, _VDB, _VDBF, _VDBFNTX
REFER _VTERM, _VPICT, _VGETSYS
REFER _VDBG
REFER DIAL SET_BAUD
```

Figure 7 - Revised My_Pll link script file

Creating BASE50.PLL

As previously stated, Clipper 5.0 is shipped with BASE50.PLL, a compilation of CLIPPER.LIB, EXTEND.LIB, TERMINAL.LIB and DBFNTX.LIB. If creating your own pre-link libraries is of no interest, you should, at a minimum, use BASE50.PLL. The code in this library will not, of course, change and you will experience quicker linking times. If you would like to re-create BASE50.PLL, you can use the link script file that appears in Figure 6.

A few important points should be made. First, the capitalisation of the references is critical. As explained, `REFER` is responsible for pulling in certain modules. Changing lower-case to upper-case or vice versa will affect what modules are included in BASE50.PLL.

Second, if you want to create your own pre-link library that includes the above libraries, simply modify the link script file. All you need to do is change the output file name, include the appropriate libraries and object code files, and insert the correct references. For example, if I wanted to include the Clipper libraries in MY_PLL.PLL, I would use the link script file that appears in Figure 7.

Conclusion

Pre-link libraries are a great benefit to anyone who develops with Clipper. They decrease link times, disk space, and modem transfer times. These three benefits far outweigh the two minor drawbacks of a slightly increased load size and modest increase in vulnerability to dopey users. After experimenting with pre-link libraries, I am pleasantly surprised and plan to incorporate them into all of my future 5.0 applications.

Aric Rosenbaum is President of AR Consulting, Inc. His firm, located near New York City, specialises in the creation of custom software for a growing list of local and global clients. Aric is very interested in your comments and can be reached in the US on 0101 201 301 0909 (telephone), 0101 201 301 0128 (fax) or on CompuServe as 72460,1177.

Great Expectations

Le Compiler Nouveau est arrivé! Paul Kemp has been poring over a pre-release copy of Microsoft C/C++ version 7.0 - the world's most long-awaited compiler.

No one can accuse Microsoft of a headlong rush to OOP. The compiler giant has been quietly biding its time while its competitors push out new versions of their C/C++ compilers with evangelical zeal. Microsoft C/C++ 7.0 (C/C++7) has been a long time coming but it represents a colossal upgrade. To merely bump up the version number from 6.0 to 7.0 seems almost self-deprecating on the part of the company. I must stress that this article is very much a 'first impressions' overview of the product. There are two reasons for this: One, at the time of writing, the product was still at a beta V5.0 (called 'Pete' after Pete Best the Beatle - previous betas were named 'John', 'Paul', 'George' and 'Ringo'). It would therefore be unwise and unfair to benchmark the compiler and IDE properly. Two, we plan to do an in-depth analysis of the product in a future issue of *.EXE*. This will probably be when the next release of the compiler (probably v7.1) is available.

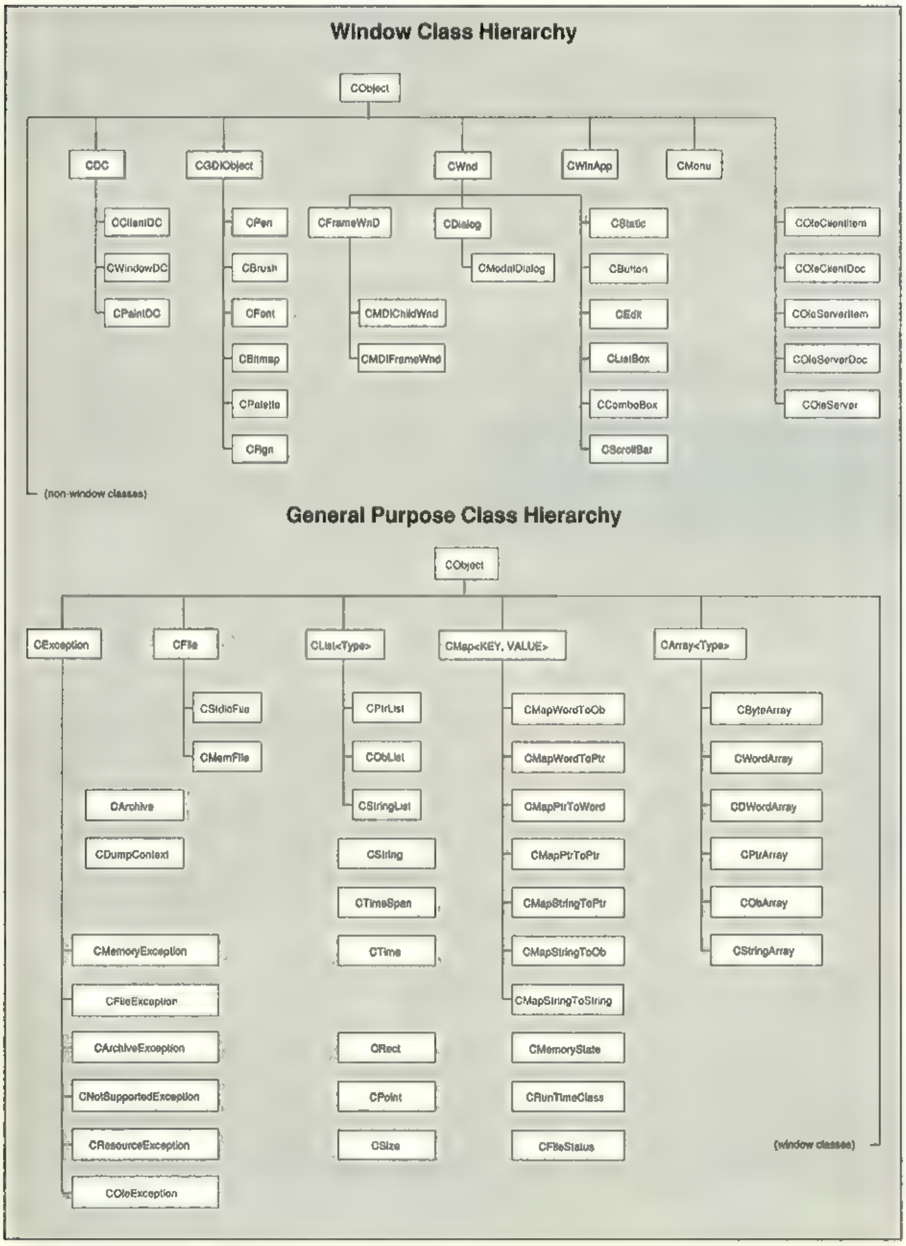

Figure 1 - Microsoft Foundation Classes (MFC) hierarchy

The basics

C/C++7 is a 32-bit protected mode C and C++ (v2.1) compiler, although as yet it does not support the creation of 32-bit DOS or Windows applications (this will be rectified in the next release). Microsoft has dropped support for low-end development machines altogether and the product requires an 80386 processor (or higher) and at least 4 MB RAM. The compiler, linker and PWB are DPMI-hosted under DOS, or can be run in a DOS box under Windows. In another controversial move, all support for OS/2 has been withdrawn. Such action is surely counter-productive when other software vendors are breaking their backs to provide cross-platform support for their products. However, Microsoft UK Head of Languages, Andrew King, did indicate that there is a good chance of the compiler supporting OS/2 v2.0 in a future incarnation.

The basic Windows SDK has disappeared (at last) and all the necessary tools for developing Windows apps (Dialog Editor, Font Editor, Bitmap Editor etc) are 'in the box' along with the resource compiler, header files and libraries. Specialist SDKs, for things like multimedia and pen extensions, still have to be purchased separately.

CodeView, now up to version 4.0, has been rewritten from scratch and implements a host of improvements, including full sup-

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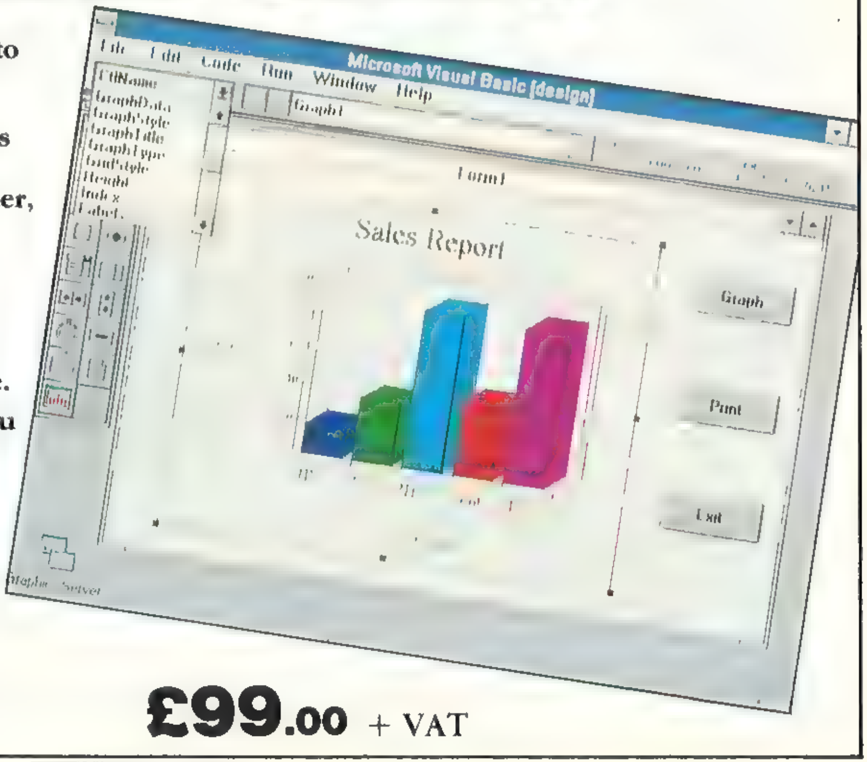

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port for C++, remote debugging (via RS232 serial link) and DOS-extended applications. The Programmer's WorkBench (PWB), much-criticised when it first appeared in v6.0, has also been revamped in version 2.0. A new overlay manager called MOVE (Microsoft Overlay Virtual Environment) is also included in the package to compete with Borland's VROOMM, and a copy of the company's Source Profiler - previously only available as a seperate product - has been thrown in for good measure.

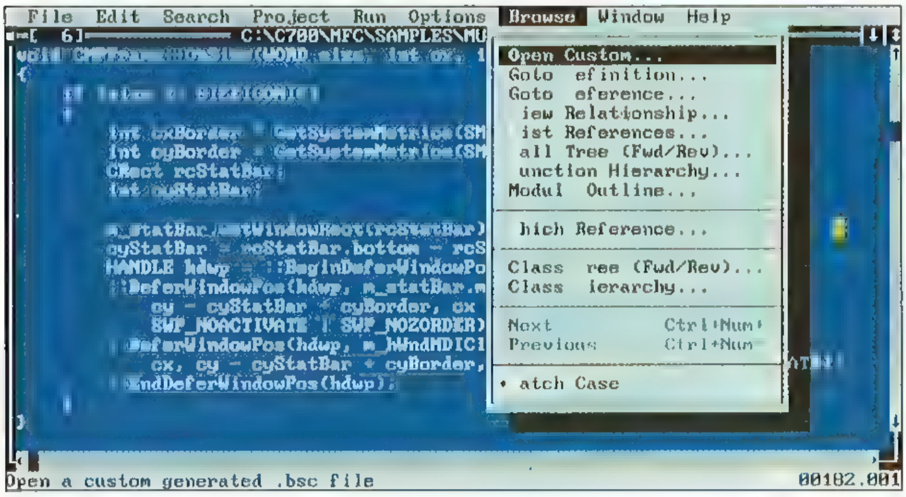
What's new?

Obviously the major new feature of C/C++7 is its support for C++, but it is also an upgrade of C 6.0 for straight C programmers. A number of new size and speed optimisations have been introduced including the facility to generate packed code or 'p-code'. This technology has been used internally at Microsoft for several years and is employed in some of its home-grown applications such as Word, Excel and PowerPoint. P-code can shrink the memory requirements of an application by 40 to 60 percent, although of course there is a run-time overhead. For DOS programs it may be used to compress code that might otherwise require overlays, and under Windows it is advantageous to have programs as small as possible to allow the operating system to juggle memory more effectively.

With p-code, application source code is compiled into 'interpreted object code', which is a higher-level and more compact representation of object code. A small (9 KB) interpreter module is then linked into the application so that no other special software needs to be loaded.

P-code generation is turned on by a simple compiler optimisation switch (/Oq) and requires little effort on the part of the programmer. A `#pragma` directive can also be used to generate p-code for selected non-time-critical functions in a single source file, so that p-code and native code can be included in the same object file.

Microsoft recommends that user-interface code is a good candidate for p-code because under Windows the user perceives almost no decrease in speed (presumably because Windows itself is so slow).

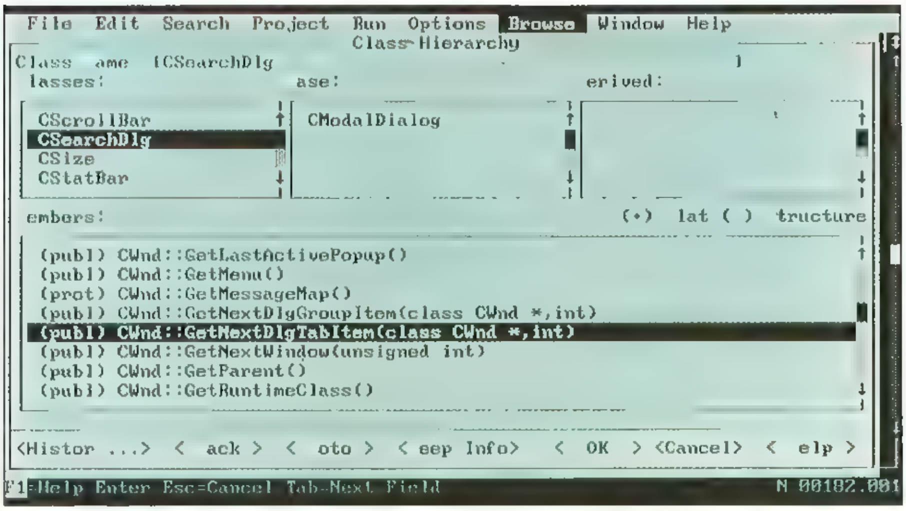


```
v[illegible] (WORD size, int cx, i
{
    if [illegible] != SIZEICONIC)
    {
        int cxBorder = GetSystemMetrics(SM
        int cyBorder = GetSystemMetrics(SM
        CRect rcStatBar;
        int cyStatBar;

        m_statBar.GetWindowRect(rcStatBar)
        cyStatBar = rcStatBar.bottom - rcS
        HANDLE hdwp = ::BeginDeferWindowPo
        ::DeferWindowPos(hdwp, m_statBar.m
            cy - cyStatBar + cyBorder, cx
            SWP_NOACTIVATE | SWP_NOZORDER)
        ::DeferWindowPos(hdwp, m_hWndMDICl
            cx, cy - cyStatBar + cyBorder,
        ::EndDeferWindowPos(hdwp);
    }
}
```

Open a custom generated .bsc file 00182.001

Figure 2 - PWB's Browse menu


File Edit Search Project Run Options Browse Window Help
Class Hierarchy
<Histor ...> < ack > < oto > < eep Info> < OK > <Cancel> < elp >

```
Class ame [CSearchDlg                    ]
lasses:                ase:                erived:
 CScrollBar            CModalDialog
 CSearchDlg
 CSize
 CStatBar
embers:                            (•) lat ( ) tructure
 (publ) CWnd::GetLastActivePopup()
 (publ) CWnd::GetMenu()
 (prot) CWnd::GetMessageMap()
 (publ) CWnd::GetNextDlgGroupItem(class CWnd *,int)
 (publ) CWnd::GetNextDlgTabItem(class CWnd *,int)
 (publ) CWnd::GetNextWindow(unsigned int)
 (publ) CWnd::GetParent()
 (publ) CWnd::GetRuntimeClass()
```

F1=Help Enter Esc=Cancel Tab=Next Field N 00182.001

ADVANCED BUSINESS GRAPHICS

Figure 3 - PWB's class hierarchy browser

Enhanced speed optimisations include unrestricted function inlining, automatic function inlining and better near data allocation.

Microsoft also claims to have dramatically improved compilation speeds with C/C++7. I must confess that on the admittedly trivial applications that I tested, I did not find a significant improvement over C 6.0. However, I shall reserve judgement until a retail version of the compiler can be tested. Taking the cue from Borland C++, Microsoft has now implemented pre-compiled headers. The use of these obviously can reduce compilation times greatly. Microsoft's implementation has the advantage over Borland's of allowing executable code to be pre-compiled as well as header information. An unfortunate side-effect of this flexibility is that it is more cumbersome to use than Borland's offering. Because literally anything can be in a pre-compiled header, the programmer has to tell the compiler where the 'header' stops. This is done by embedding a `#pragma hdrstop` in the source file (see Figure 5). A pre-compiled header file has to be explicitly created, maintained and used through a number of compiler switches.

One of the main criticisms levelled at MSC6 was its inadequate documentation. Microsoft has responded to this by supplying heaps of the stuff with version 7.0. The 10-manual set runs to about 5,000 pages and is pretty comprehensive. Most of the information is also available online in the PWB (although I'm not a fan of the PWB's Help system - even though there is a new Global Search option).

C++

The C++ compiler of C/C++7 is a full implementation of the AT&T version 2.1 language specification including support for true nested types (ie proper scoping of 'class within a class'-type declarations). Microsoft has also included prototype versions of more advanced C++ features such as templates and exception handling (Borland C++ V3.0 implements templates as part of the language, but has no mechanism for exception handling at all).

Exception handling is implemented as a system of macros which expand to C++ control structures and function calls. Although not identical to the proposed ANSI implementation, it should be relatively easy to port code written using the macros when the facility becomes part of the language proper. For example, in C/C++7:

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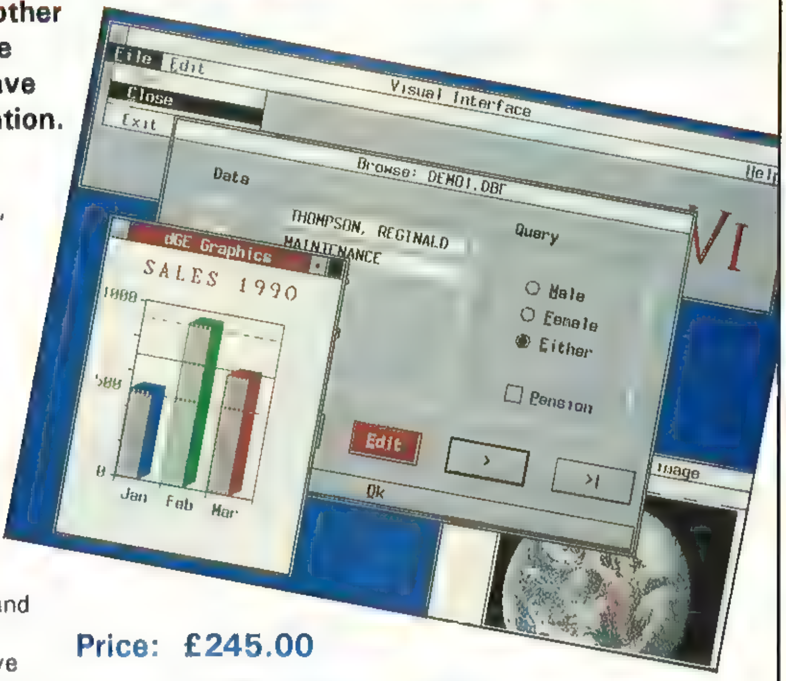

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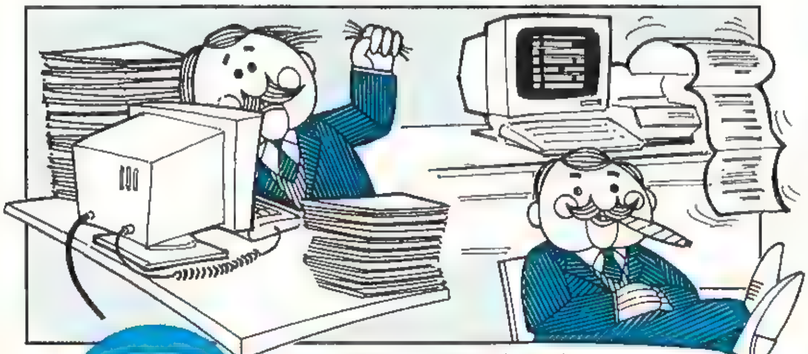

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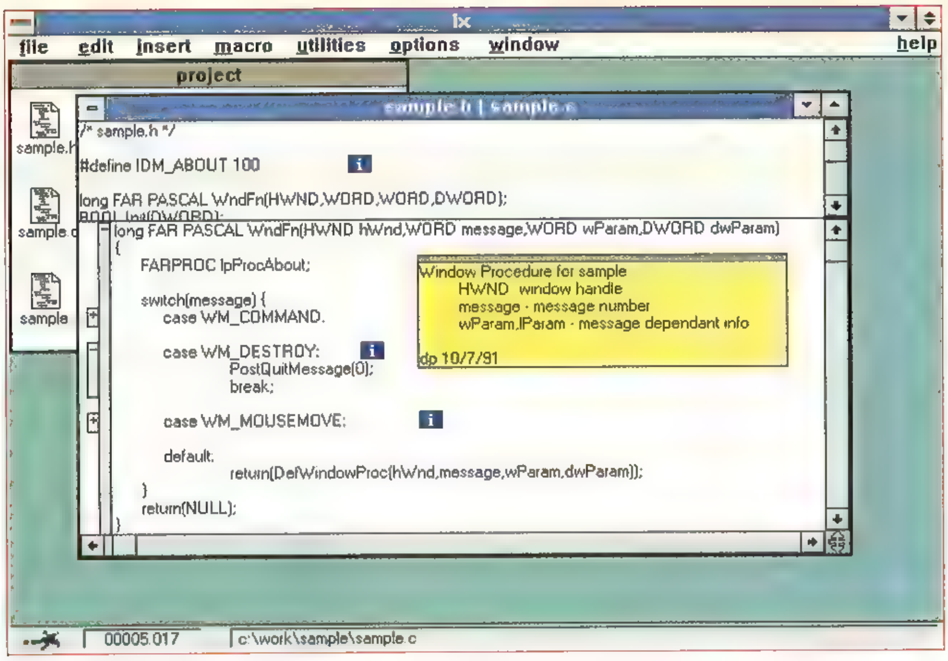

```
/* sample.h */

#define IDM_ABOUT 100

long FAR PASCAL WndFn(HWND,WORD,WORD,DWORD);
BOOL Init(DWORD);
```

```
long FAR PASCAL WndFn(HWND hWnd,WORD message,WORD wParam,DWORD dwParam)
{
    FARPROC lpProcAbout;

    switch(message) {
        case WM_COMMAND.

        case WM_DESTROY:
                PostQuitMessage(0);
                break;

        case WM_MOUSEMOVE:

        default:
                return(DefWindowProc(hWnd,message,wParam,dwParam));
    }
    return(NULL);
}
```

```
Window Procedure for sample
    HWND  window handle
    message - message number
    wParam,lParam - message dependant info

dp 10/7/91
```

As more and more users switch to Windows 3, the demand for Windows software continues to grow. Yet much of the developer's toolkit still runs under DOS. Writing for Windows has always been more complex than for DOS, and project management can be especially tricky as Windows programs tend to be made up of large numbers of files.

ix was developed to enhance programmer productivity. ix runs under Windows, and uses all the standard GUI features – MDI, split windows, cut & paste, choice of fonts and colours. It also contains several unique features which allow the developer far greater control.

With ix you can edit and test within Windows – no more switching in and out of a DOS editor. Compilation/make files can be launched from a 'Browse' window.

Browse windows help you keep track of the multiple files of a Windows project. A browser can be created for each project and used to fire up edit windows, launch resource editors (such as SDKpaint) and run programs as in Program Manager.

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```
//*******************************************************************
//                    Borland C++ OWL Application
//*******************************************************************
#include <owl.h>
#include "winres.h"
extern "C"
{
  #include <stdio.h>
  #include <time.h>
  #include <string.h>
};
#define WM_MYMSG WM_USER + 1
//********************** Class Definitions **********************
class MyApp : public TApplication
{
public:
  MyApp( LPSTR AName, HANDLE hInstance, HANDLE hPrevInstance,
         LPSTR lpCmdLine, int nCmdShow )
  : TApplication( AName, hInstance, hPrevInstance,lpCmdLine,
                 nCmdShow ) {}
  void InitMainWindow();
};
class MainWnd : public TWindow
{
private:
  int     num_msgs;
  time_t  start;
  char    text[100];
public:
  MainWnd( PTWindowsObject AParent, LPSTR ATitle );
  void TimeMessages( RTMessage ) = [CM_FIRST + IDM_TIMECOUNT];
  void MyMsg( RTMessage )         = [WM_FIRST + WM_MYMSG];
  void WMPaint( RTMessage );
  void WMMouseMove( RTMessage )  = [WM_FIRST + WM_MOUSEMOVE];
  void WMActivate( RTMessage );
  void WMCreate( RTMessage );
  void WMHScroll( RTMessage );
  void WMLButtonDown( RTMessage );
  void WMMove( RTMessage );
  void WMSize( RTMessage );
  void WMVScroll( RTMessage );
  void WMDestroy(RTMessage);
};
//******************** Implementation code*****************
// Main program loop
int PASCAL WinMain( HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR  lpCmdLine, int    nCmdShow )
{
  MyApp ma( "Borland OWL Application", hInstance, hPrevInstance,
            lpCmdLine,  nCmdShow );
  ma.Run();
  return ma.Status;
}
//======================
// Initialise main window
//======================
void MyApp :: InitMainWindow()
{
  MainWindow = new MainWnd( NULL, Name );
}
//==========
// MainWnd
//==========
//------------
// Constructor
//------------
MainWnd :: MainWnd( PTWindowsObject AParent, LPSTR ATitle )
: TWindow( AParent, ATitle )
{
  num_msgs = 0;
  strcpy( text, "Select menu item to start test" );
  AssignMenu( "MainMenu" );
}
//-----------------
// EVENT HANDLERS
//-----------------
void MainWnd :: TimeMessages( RTMessage )
{
  // initialise data
  num_msgs = 0;
  strcpy( text, "Processing messages..." );
  InvalidateRect( HWindow, NULL, TRUE );
  UpdateWindow( HWindow );
  time( &start );
  PostMessage( HWindow, WM_MYMSG, 0, 0 );
}
void MainWnd :: MyMsg( RTMessage )
{
  if ( num_msgs < 10000 )
  {
    num_msgs++;
    PostMessage( HWindow, WM_MYMSG, 0, 0 );
  }
  else
  {
    time_t end;
    time( &end );
    int elapsed = difftime( end, start );
    sprintf( text, "Time taken to process 10,000 messages = %d
         seconds",  elapsed );
```

Figure 4 - Borland OWL TIMER.CPP

```
//*******************************************************************
//                    Microsoft C++ MFC Application
//*******************************************************************
#include <afxwin.h>
#include "winres.h"
extern "C"
{
  #include <stdio.h>
  #include <string.h>
};
#define WM_MYMSG WM_USER + 1
#pragma hdrstop
//********************* Class Definitions **********************
class MyApp : public CWinApp
{
public:
  BOOL InitInstance();
};
class MainWnd : public CFrameWnd
{
private:
  int     num_msgs;
  CTime   start;
  CString text;
public:
  MainWnd();
  void afx_msg TimeMessages();
  LONG afx_msg MyMsg( UINT wParam, LONG lParam );
  void afx_msg OnPaint();
  void afx_msg OnMouseMove( UINT flags, CPoint point );
  void afx_msg OnActivate( WORD state, CWnd * pOther, BOOL bMinimised );
  int  afx_msg OnCreate( LPCREATESTRUCT pCreateStruct );
  void afx msg OnHScroll( WORD SBcode, WORD pos, CWnd * pScrollBar );
  void afx_msg OnLButtonDown( WORD flags, CPoint point );
  void afx_msg OnMove( int x, int y );
  void afx_msg OnSize( UINT type, int cx, int cy );
  void afx_msg OnVScroll( WORD SBcode, WORD pos, CWnd * pScrollBar );
  void afx_msg OnDestroy();
  DECLARE_MESSAGE_MAP()
};
//*********************** Implementation code
*****************************
// Instantiate global application object
MyApp theApp;
//======================
// Initialise main window
//======================
BOOL MyApp :: InitInstance()
{
  m_pMainWnd = new MainWnd();
  m_pMainWnd->ShowWindow( m_nCmdShow );
  m_pMainWnd->UpdateWindow();
  return TRUE;
}
//==========
// MainWnd
//==========
//--------------------------------------------
//       Create message map for MainWnd
//--------------------------------------------
BEGIN_MESSAGE_MAP( MainWnd, CFrameWnd )
  ON_COMMAND( IDM_TIMECOUNT, TimeMessages ) // menu message
  ON_MESSAGE( WM_MYMSG, MyMsg )              // user-defined message
  ON_WM_PAINT()                             // event handlers...
  ON_WM_MOUSEMOVE()
  ON_WM_ACTIVATE()
  ON_WM_CREATE()
  ON_WM_HSCROLL()
  ON_WM_LBUTTONDOWN()
  ON_WM_MOVE()
  ON_WM_SIZE()
  ON_WM_VSCROLL()
  ON_WM_DESTROY()
END_MESSAGE_MAP()
//------------
// Constructor
//------------
MainWnd :: MainWnd()
{
  num_msgs = 0;
  text     = "Select menu item to start test";
  Create( NULL, "Microsoft MFC Application",
          WS_OVERLAPPEDWINDOW, rectDefault, NULL, "MainMenu" );
}
//-----------------
// EVENT HANDLERS
//-----------------
void MainWnd :: TimeMessages()
{
  // initialise data
  num_msgs = 0;
  text     = "Processing messages...";
  InvalidateRect( NULL, TRUE );
  UpdateWindow();
  start = CTime::GetCurrentTime();
  PostMessage( WM_MYMSG, 0, 0 );
}
LONG MainWnd :: MyMsg( UINT, LONG )
{
  if ( num_msgs < 10000 )
  {
    num_msgs++;
    PostMessage( WM_MYMSG, 0, 0 );
  }
  else
  {
```

Figure 5 - Microsoft MFC TIMER.CPP

```
    InvalidateRect( HWindow, NULL, TRUE );
  }
}
void MainWnd :: WMPaint( RTMessage )
{
  RECT        rect;
  PAINTSTRUCT ps;
  HDC         hDC = BeginPaint( HWindow, &ps );
  GetClientRect( HWindow, &rect );
  SetTextAlign( hDC, TA_BASELINE | TA_CENTER );
  SetBkMode( hDC, TRANSPARENT );
  TextOut( hDC, ( rect.right / 2 ), ( rect.bottom / 2 ),
           text, strlen(text) );
  EndPaint( HWindow, &ps );
}
void MainWnd :: WMActivate( RTMessage msg )
{
  TWindow::WMActivate( msg );
}
void MainWnd :: WMMouseMove( RTMessage msg )
{
  TWindow::DefWndProc( msg );
}
void MainWnd :: WMCreate( RTMessage msg )
{
  TWindow::WMCreate( msg );
}
void MainWnd :: WMHScroll( RTMessage msg )
{
  TWindow::WMHScroll( msg );
}
void MainWnd :: WMLButtonDown( RTMessage msg )
{
  TWindow::WMLButtonDown( msg );
}
void MainWnd :: WMMove( RTMessage msg )
{
  TWindow::WMMove( msg );
}
void MainWnd :: WMSize( RTMessage msg )
{
  TWindow::WMSize( msg );
}
void MainWnd :: WMVScroll( RTMessage msg )
{
  TWindow::WMVScroll( msg );
}
void MainWnd :: WMDestroy( RTMessage msg )
{
  TWindow::WMDestroy( msg );
}
```

Figure 4 - Borland OWL TIMER.CPP (Continued)

```
    CTime     end     = CTime::GetCurrentTime();
    CTimeSpan elapsed = end - start;
    char buffer[100];
   sprintf( buffer, "Time taken to process 10,000 messages = %d seconds",
    elapsed.GetTotalSeconds() );
    text = buffer;
    InvalidateRect( NULL, TRUE );
  }
  return 0L;
}
void MainWnd :: OnPaint()
{
  CRect     rect;
  CPaintDC  dc( this );
  GetClientRect( rect );
  dc.SetTextAlign( TA_BASELINE | TA_CENTER );
  dc.SetBkMode( TRANSPARENT );
  dc.TextOut( (rect.right / 2), (rect.bottom / 2),
              text, text.GetLength() );
}
void MainWnd :: OnMouseMove( UINT flags, CPoint point )
{
  CFrameWnd::OnMouseMove( flags, point );
}
void MainWnd :: OnActivate( WORD state, CWnd * pOther, BOOL bMinimised )
{
  CFrameWnd::OnActivate( state, pOther, bMinimised );
}
int MainWnd :: OnCreate( LPCREATESTRUCT pCreateStruct )
{
  return CFrameWnd::OnCreate( pCreateStruct );
}
void MainWnd :: OnHScroll( WORD SBcode, WORD pos, CWnd * pScrollBar )
{
  CFrameWnd::OnHScroll( SBcode, pos, pScrollBar );
}
void MainWnd :: OnLButtonDown( WORD flags, CPoint point )
{
  CFrameWnd::OnLButtonDown( flags, point );
}
void MainWnd :: OnMove( int x, int y )
{
  CFrameWnd::OnMove( x, y );
}
void MainWnd :: OnSize( UINT type, int cx, int cy )
{
  CFrameWnd::OnSize( type, cx, cy );
}
void MainWnd :: OnVScroll( WORD SBcode, WORD pos, CWnd * pScrollBar )
{
  CFrameWnd::OnVScroll( SBcode, pos, pScrollBar );
}
void MainWnd :: OnDestroy()
{
  CFrameWnd::OnDestroy();
}
```

Figure 5 - Microsoft MFC TIMER.CPP (Continued)

```
TRY
{
  do_something();
}
CATCH( ExceptionClass, e )
{
  // e is an instance of the
  // exception object
  ...
}
AND_CATCH( ExceptionClass, e )
{
  ...
}
END_CATCH
```

System proposed by Stroustrup:

```
try
{
  do_something();
}
catch( ExceptionClass e )
{
  ...
}
catch( ExceptionClass e )
{
  ...
}
```

Template definition is also at a prototype stage and declarations must be converted to v2.1-compliant header files and .CPP files using a TEMPLDEF utility (for which the source code is provided). This is not too much of a hindrance, given that a number of common templates are provided in the class libraries shipped with the product, and programmers will not often need to define their own. As with exception handling, Microsoft plans to incorporate templates (and any other syntax) into the language proper only when an ANSI standard is available.

Class libraries

The availability of high-quality class libraries is perhaps the most important factor in taking full advantage of OOP and C++. With C/C++7, Microsoft has included an extensive range of DOS and Windows classes collectively referred to as Microsoft Foundation Classes (MFC - Figure 1). This group of classes is part of a wider hierarchy called Application Framework Extensions (AFX). The framework is incomplete at the moment (consisting only of the MFC group) but will be filled out in the compiler's next release. Full source code is included for all classes.

It can be seen that the MFC hierarchy is 'flat' or 'granular', meaning that there are not many levels in the tree. There are relatively few classes, but they have many methods. Most objects are derived from a superclass `CObject`. Unlike Borland's ObjectWindows Library (OWL), the MFC Windows classes encapsulate almost the whole of the Windows API, so one should not need to 'kickdown'. Microsoft has also provided an excellent range of general utility classes such as `CString` and `CTime`.

Dealing efficiently with message handling in GUI environments has become a moot point in C++ circles. The problem is that because Windows itself is not truly object-oriented you end up with enormous virtual function tables and are still left with a slow `switch` structure in a main window procedure (or 'dispatcher'). Borland got round the problem by a language extension whereby a Windows message number is associated with a virtual function in the

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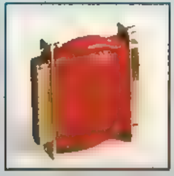

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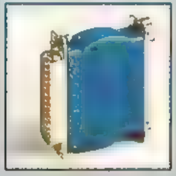

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class declaration (*see .EXE Nov '91*). Microsoft has taken a slightly different approach by using a system of macros and the addition of the `afx_msg` keyword. The keyword acts a bit like the `virtual` method modifier but does not have its implicit behaviour when it comes to inheritance - the macros you use have to tell the compiler what is the object's immediate base class.

Using Borland's OWL library, the array of pointers to a window's event handlers and their associated message numbers is generated by the compiler and held as a Dynamic Dispatch Virtual Table (DDVT) adjacent in memory to the class's ordinary Virtual Method Table (VMT). With MFC, the `DECLARE_MESSAGE_MAP()` macro declares a similar array of pointers and numbers within the class declaration. This array is then subsequently initialised in a `BEGIN_MESSAGE_MAP()` macro block. When a window receives a message, a small assembler routine searches the array and matches the number with a function pointer in a similar way to Borland's OWL.

OWL vs MFC

In order to test the relative efficiency of the two message routing systems and to examine the ease of Windows development using the class libraries, I devised a simple application. The program is called TIMER and it measures the time taken (in seconds) to process 10,000 user-defined messages. The timer is kicked off by selecting a menu item, and the elapsed time is displayed in the centre of the client window area. A number of simple information messages are also displayed. The source code for OWL and MFC versions of this application are listed in Figures 4 and 5. To make the test a bit more realistic I inserted a number of extra 'dummy' event handlers to generate a reasonably sized message array. I also tested the programs 'under stress' by repeating the timer experiment while moving the mouse pointer rapidly over the client window, thus generating thousands of `WM_MOUSEMOVE` messages.

The results of this test are tabled in Figure 6. It can be seen that the MFC application did not appear to process the messages as rapidly as its OWL equivalent. I am wary of drawing too many conclusions from this because it is such a simple application, but it may indicate an area where Microsoft could make improvements. Microsoft compile and link times were also slower but .EXE sizes were considerably smaller than their OWL counterparts. This is mainly due to Microsoft's new 'smart-method' linker (similar to that supplied by JPI) which strips out unused methods from the executable. The MFC source was slightly longer, primarily because of the need to declare the message map entries. This I found a bit annoying because it means that the programmer effectively has to declare a window's event handlers twice - once in the class definition and again to initialise the message map. Message handling functions in MFC also have distinct prototypes (ie they receive different parameters and return different values). This is good in one respect because it means that the standard Windows message parameters have already been decoded into meaningful data (eg a mouse coördinate). A downside of this is that it is necessary to look up and declare the exact prototype of an event handler you wish to override.

Other matters

The PWB has a very powerful class browser. Browse information is generated at compile time by a set of compiler options. These cause the creation of separate .SBR files which are then 'compiled' to a .BSC browse database with the BSCMAKE utility.

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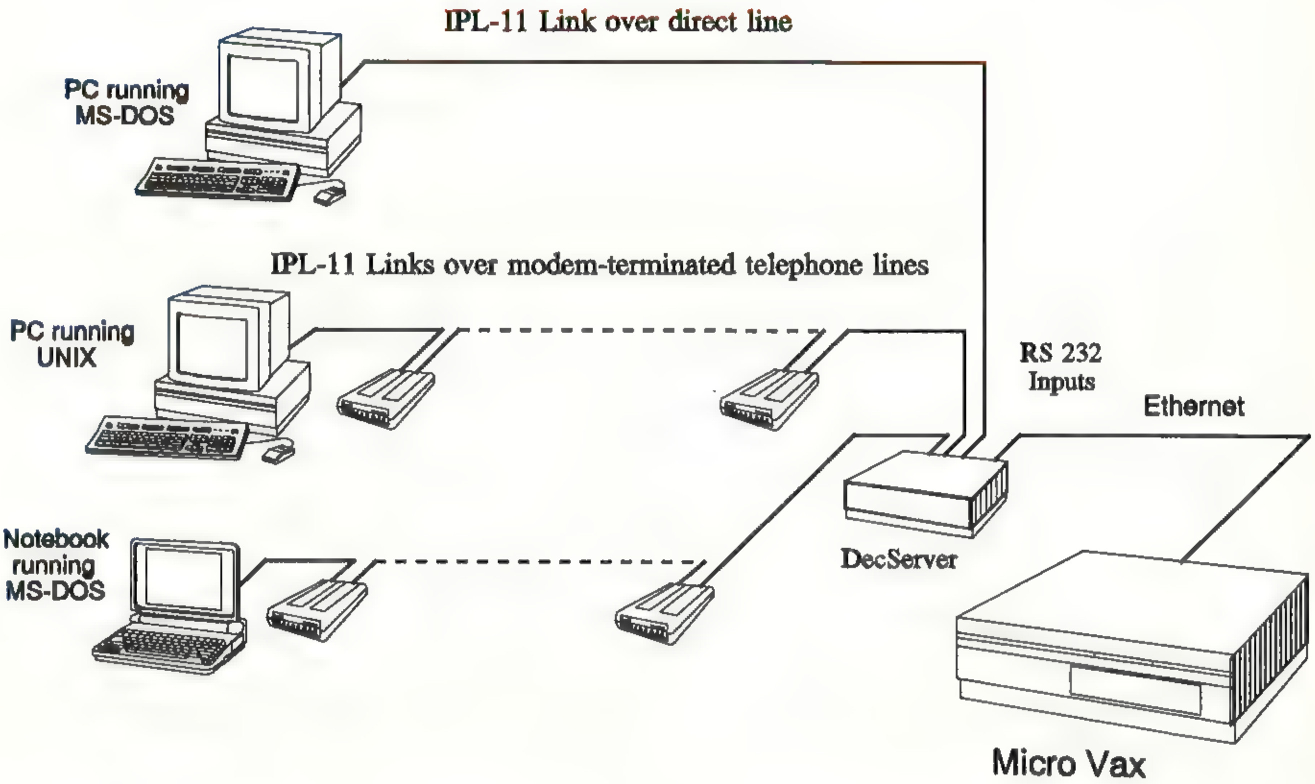

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Because the browse information is not contained in the .EXE file, there is no overhead and a great deal of detailed cross-reference information can be stored. In Turbo C++ for Windows, similar data is burned into the executable and is not nearly as detailed as that available in C/C++7. With the PWB's class browser you can: display a list of all classes and their members in a 'tree' format (this is useful but not as good as a true graphical view); view all classes sorted by protection and scope; view all relationships between classes, class symbols, objects and member functions. Figures 2 and 3 show the PWB's class browser in action.

Conclusion

Microsoft has been very careful not to jump the gun in the race to C++ - one might even suggest that they have been slow off the blocks. But C++ is still an evolving language with many features not yet standardised. Microsoft's goal has been to produce a robust, reliable and above all *correct* implementation of C++, which is a highly complex language with many pitfalls for compiler-writers.

First impressions indicate that, despite improvements, C/C++7 is still a bit on the slow side with regard compilation speed, but I must state again that I was dealing with a beta version. I was also expecting great improvements in the PWB but was somewhat disappointed.

Compiler C++ Windows Library		Turbo C++ for Windows ObjectWindows (OWL)	Microsoft C/C++ 7.0 MS Foundation Classes (MFC)
Compile & link time	-pch -debug	55s	1m 15s
	-pch +debug	1m 11s	2m 20s
	+pch -debug	40s	47s
	+pch +debug	55s	1m 32s
.EXE size (bytes)	-pch -debug	57344	34304
	-pch +debug	127254	67584
	+pch -debug	57344	34304
	+pch +debug	127063	67584
Number of lines of code		162	168
Time taken to process 10,000 messages (secs)	-mouse mvt	8	10
	+mouse mvt	10	13

NOTE: pch = pre-compiled header
Data for a 25 MHz / 386-based PC with 4 MB RAM

Figure 6 - Comparison of OWL and MFC versions of TIMER

The class libraries supplied are very extensive and contain heaps of code to aid debugging. It does, however, seem a shame that vendors (Microsoft and Borland) have had to resort to language extensions/macros to implement compiler-dependent solutions to the 'Windows Problem'.

Worth the wait? Yes, I think so. Microsoft's commitment to producing code of the highest quality should ensure that C++ becomes more widely used for major development projects. As always, there is room for improvement, but I think the release of C/C++7 will herald the true dawn of C++.

EXE

Microsoft C/C++ version 7.0 will cost £335. Existing users of C 6.0 or (wait for it) any other C/C++ compiler (eg Borland, Zortech, JPI etc) can get a copy for £150. C/C++7 should start shipping at the end of February. Microsoft is on 0734 500741.

Programmer's Editors

They say that a programmer's editor is his best friend. Cliff Saran looks at five offerings.

A Programmer's Editor is probably the least considered programming aid. Before the birth of the PC, mainframe programmers had to rely on a systems editor. Today, the evolution of the standalone editor has produced a highly configurable beast, offering an environment for editing and compiling that is superior to its IDE cousins. In this article, I shall be looking at five Programmer's Editors varying considerably in price, complexity and the features that they have to offer.

QEdit

While I was compiling a list of editors for this article, I came across a rather good-looking shareware offering called QEdit. QEdit provides many features that put it above more basic editors.

First, it is fast. Even the largest file it could handle (about 490 KB) in my DOS setup it took milliseconds to load. Figure 1 shows a benchmark test that I ran on all the editors in this article. Buffer size is limited by the amount of free memory on your machine. In fact, you can open as many files as you like, as long as you have enough free memory left. Since this memory pool is central to the functionality of QEdit, if you are using a large Scratch buffer (eg during a Cut/Copy and Paste operation) it is best to flush the buffer once you've finished using it (by copying something smaller into it).

... Epsilon is the only editor to support concurrent processing

	QEdit	Ed	Epsilon	Brief	PVCS
Manufacturer	SemWare	Soft as it Gets	Lugaru's Software	Solution Systems	Polytron/ Sage
Largest Buffer Size	497 KB	100 MB	x	x	x
Largest Cut/Copy Block	270 KB	x	x	x	x
Resident in DOS shell	60 KB	8 KB	5 KB	6 KB	6 KB
Maximum Line Length (chars)	512	1024	x	512	x
Maximum Number of Lines	15868	65000	x	x	x
Maximum Number of Windows	8	8	256	32	256
Maximum Number of Open Files	-	30	x	x	x
Save Session info	No	Yes	No	Yes	Yes
Cut/Copy Block delay (secs)	x	5	3	4	x
Paste Block delay (secs)	x	75	x	37	x
Search & Replace delay (secs)	7	155	25	18	28
WordStar Configuration	No	Yes	No	No	Yes
Brief Configuration	No	Yes	No	Yes	Yes
Menu System	Yes	Yes	No	No	Yes
Keyboard Macro	Yes	Yes	Yes	Yes	Yes
Macro Language	No	Yes	Yes	Yes	Yes

- - Does not apply
x -Insignificant

The above benchmark was performed using a 40MHz 386 with 4Mb of RAM running MS-DOS V5.0. The **Cut** and **Paste** times were found by timing how long the editors took to perform these operations using a block size of 70KB. The **Search and Replace** times indicate the time taken for each editor to perform 4096 replacements (replacing the string 'ALongWindowsVar' with 'AShortWindowsVar'). The values for the 'Resident in DOS Shell' show how much memory the editor uses when running in a DOS shell.

Figure 1 : Programmer's Editors Benchmark

Second, it is easy to use. There's a menu system (activated with <ESC>), a status bar and a handy pop-up help screen that shows the key sequences for those frequently used operations (like Loading files or Cutting and Pasting). QEdit provides three ways to mark a block of text. A block may be marked as a group of rows or columns. Moving columns provides the easiest way to align a group of comments with the right margin or to add another level of indentation to a block of code in a loop construct. The block may then be manipulated using a single key stroke (eg the grey '-', '+' and '*' keys perform cut, copy and paste operations respectively).

Since QEdit is quite a small program, using only 58 KB of memory, it leaves enough room in a DOS shell to run your favourite compiler. There is no way to trap compilation errors but the ability to compile within an editing session is a great advancement over using a command-line compiler - at least when you return to your editing session it will remain in the same state as you left it (this is essential in QEdit as it doesn't save session info when you quit).

QEdit is configurable. It uses a separate program (QCONFIG.EXE) to change the working environment, and it has a keyboard macro recorder. It supports C-style indentation and there's also a built-in parenthesis/bracket matching macro. Unfortunately, it is not possible to change the printer port - printer output is *hard-wired* to `LPT1`.

QEdit provides all of the basic requirements of a good Programmer's Editor. There's limited support for C programming style and compiling within the editor (although it doesn't highlight the erroneous line like some of the more up-market offerings).

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CIRCLE NO. 468

Unlike more complex editors, QEdit only uses a single executable (47 KB) so you can stick it onto a single floppy disk and run it on any machine you're using. You can register your copy of QEdit directly to SemWare in the US by sending $54.95 (+$10 shipping). However QEdit is also distributed in the UK (see Figure 5 for prices). A TSR and OS/2 version of QEdit is also available.

Ed

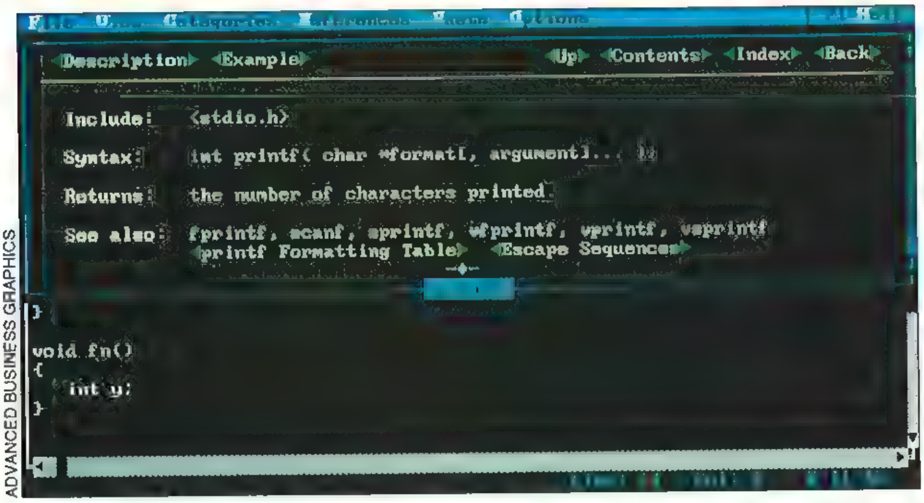
You probably haven't heard about Ed yet, so I'll just put you in the picture. Ed began its life a long time ago (pre-CP/M) and was first ported to CP/M 80 and then on to DOS. In early 1990, the Australian company, Soft As It Gets, released a commercial version.

There is a Status Bar at the top of the screen and a Function Key template at the bottom. This template shows what action each function key (F1 to F10) performs. A pull-down menu can also be activated which gives the short-cut key strokes. There's also a context-sensitive Help system and online documentation. Standard editing functions like highlighting a rows or column of text are, of course, present. Ed supports extremely large files and utilises a virtual memory mechanism for swapping sections of a large file from memory to disk and vice-versa. There can be up to eight windows on the screen at any one time and each window may be created by splitting the screen either horizontally or vertically. Files may be loaded in edit-mode or view-only, enabling the sharing of files over a LAN.

One of the cleverest features of Brief is its ability to work with third-party software

```
Description  Example                    Up  Contents  Index  Back
Include:   <stdio.h>
Syntax:    int printf( char *format[, argument]... );
Returns:   the number of characters printed.
     printf Formatting Table  Escape Sequences
void fn()
{
   int u;
}
```

Figure 2 - Epsilon's Concurrent DOS session



```
Description  Example                    Up  Contents  Index  Back

 Include:    <stdio.h>

 Syntax:     int printf( char *format[, argument]... );

 Returns:    the number of characters printed.

 See also:   fprintf, scanf, sprintf, vfprintf, vprintf, vsprintf
             printf Formatting Table   Escape Sequences

}

void fn()
{
  int u;
}
```

ADVANCED BUSINESS GRAPHICS

Figure 3 - Context-sensitive Help in Brief

To get the most satisfaction from using Ed, you have to write C/C++ source. It directly supports Zortech C/C++, Turbo C/C++ and Microsoft C compilers and there are several built-in utilities which will ease the burden of writing code. First there's C-style indentation, parenthesis-matching and a handy line commenting macro. Then there is the template feature. Now this is a real time-saver. Templates work by replacing a single character by a complete C construct eg <ESC>s<ESC> produces the following :

```
switch (   )
{
    case :
        break;

    default :
        break;
}
```

Do you ever need to quickly look up the definition of an external function that you're using? CTAG is a program that keeps a record of C function call definitions (it also works with non-inline C++ member functions). Once all your files have been processed by CTAG, you can simply view the file containing the function definition by invoking Ed's Edit File menu option, and specifying the name of the function you wish to see. Ed will automatically load the relevant file and place the cursor on the first line of the function's definition. Ed even provides you with a function browser for moving to a given function definition within the file that you're currently editing.

There are also a few pop-up utilities bundled with ED. These include a nifty calculator that can convert from decimal to binary or hex. There's a built-in ASCII table and a table showing the C precedence rules. Although I have concentrated on ED's C programming features, I must point out that it also supports Pascal, Assembler, Modula-2, Clipper and dBASE. ED is a feature-packed editor, filled to the brim with clever ideas for writing code faster, and more efficiently.

Epsilon

Although all the Programmer's Editors in this article were tested under DOS, there are times when you'd like to use your favourite editor on a different platform (like OS/2 or UNIX). As you already know, all UNIX machines are guaranteed to have a copy of `vi`. `vi` is even available under DOS and OS/2. However, I can't see many DOS programmers moving over to `vi`! Epsilon (from Lugaru) is available for DOS, OS/2, SCO UNIX and Interactive 386/ix, providing true multi-platform editing. Unfortunately this limits its capabilities, since many UNIX terminals lack even the most basic cursor controls and text highlighting facilities.

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- Menus — Choose from pop-up, pull-down, 123-style or slug menus — or create your own.
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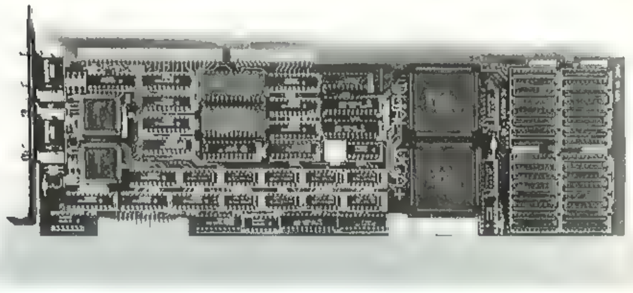

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Epsilon uses EMACS-style commands, although it is highly configurable. It has a status bar which shows the filename, type of buffer and the percentage of the buffer that has been scrolled down.

In addition to the standard text buffer, Epsilon supports a further three special buffer types - each of these may be displayed in its own window. First there is the `bufed` buffer which holds a list of buffers together with the files that are associated with them. `bufed` operates in a similar way to how the buffer list-box works on other editors. Scrolling through the list enables you to select the current buffer.

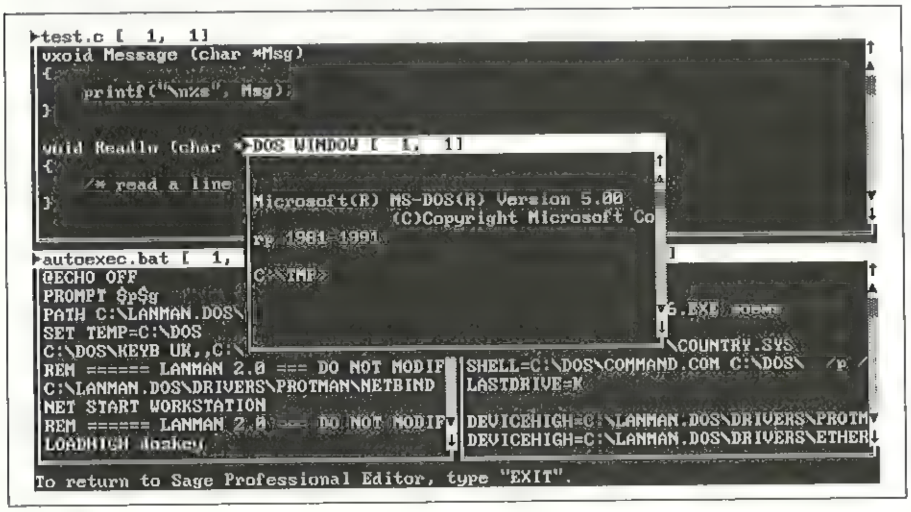
Second there's the `dired` buffer which contains a listing of the current directory. It is possible to select files for deletion using the 'D' key to place a flag on the files you want to delete. The 'X' key actually removes these files, after verifying that this is really what you want. Pressing <Enter> on a given file causes the editor to load the chosen file into the current window.

Next there is the C buffer type. When a C program is loaded into a C buffer, the editor produces C-style indentation and parenthesis/bracket matching. Compiling the contents of a C buffer is a rather involved procedure. This is because Epsilon defaults to the UNIX `make` command. To use Microsoft C you have to pass a dummy parameter to the Epsilon `make` macro which causes the macro to prompt you for a command-line. Compilation errors are trapped by Epsilon and you can step through them using <CTRL>X <CTRL>N. Epsilon also provides a `tag` facility for cross-referencing functions. Running this command on all C source files produces a list of function definitions with filenames and line numbers. However, it is not possible to select a function to read into a buffer - you have to load the file containing the function definition manually, and 'cursor-down' to the relevant bit of code. This 'tag' file is like a normal text file and can be opened any time.

SPE will even run Windows Enhanced mode from within the DOS window

Finally there is the `process` buffer. A concurrent task runs in this buffer, and what's more, it even works under DOS (see Figure 2) - Lugaru claims that Epsilon is the only DOS editor to support concurrent processing (although under DOS, Epsilon will only support one concurrent task). The main problem with the `process` buffer is that it doesn't leave enough memory in the DOS shell to run anything useful - on my machine, a typical concurrent editing session left about 150 KB for DOS (ie not enough to run a compiler or a linker). To get around this, Epsilon offers an 'Exit to DOS' command which needs only 6 KB.

I have never used EMACS before, so most of the keyboard sequences came as quite a shock. This is made worse by the fact that there isn't a menu system, so you have to remember dozens of keystrokes. Luckily the Epsilon manual is well-presented and easy to use. There is online help, but I don't recommend you use it, since it is extremely tedious. Epsilon is a fine editor, although it lacks some of the more 'user friendly' features found on most DOS editors.



```
▸test.c [   1,   1]
 vxoid Message (char *Msg)
 {
     printf("\n%s", Msg);
 }

 void Readln (char ▸DOS WINDOW [   1,    1]
 {
     /* read a line
 }                   Microsoft(R) MS-DOS(R) Version 5.00
                                  (C)Copyright Microsoft Co
                     rp 1981-1991

▸autoexec.bat [   1,                                       ]
 @ECHO OFF           C:\TMP>
 PROMPT $p$g
 PATH C:\LANMAN.DOS\                                  6.EXE
 SET TEMP=C:\DOS
 C:\DOS\KEYB UK,,C:\                                 \COUNTRY.SYS
 REM ====== LANMAN 2.0 === DO NOT MODIF SHELL=C:\DOS\COMMAND.COM C:\DOS\  /p /
 C:\LANMAN.DOS\DRIVERS\PROTMAN\NETBIND  LASTDRIVE=K
 NET START WORKSTATION
 REM ====== LANMAN 2.0 === DO NOT MODIF DEVICEHIGH=C:\LANMAN.DOS\DRIVERS\PROTM
 LOADHIGH doskey                        DEVICEHIGH=C:\LANMAN.DOS\DRIVERS\ETHER
To return to Sage Professional Editor, type "EXIT".
```

Figure 4 - Overlapping Windows in SPE

Brief

I've been reliably informed that Brief is one of the most popular Programmer's Editors for DOS and OS/2. So, why do people buy it? What do you get for two hundred quid? (Brief costs nearly as much as a good C compiler.)

Brief is supplied with a lot of documentation - over 600 pages in total, split into a user manual and a macro reference manual. There is also online Help and a context-sensitive Help system. The Help system is easy to use and provides useful info on most of Brief's features, including help on how to manipulate Blocks, Buffers, cursor controls, windows and how to perform search and replace.

There is a setup program to reconfigure Brief after it has been installed. This automatically makes changes to your `CONFIG.SYS` and `autoexec.bat` files. In addition to being able to configure the screen colours, line length, number of levels of undo etc, the setup program allows you to provide a command-line for compilation inside Brief.

Brief supports several languages including Ada, Basic, C, Cobol, Fortran, Modula-2 and Pascal. <ALT> F10 compiles the current buffer and produces a list of compilation errors in an error list-box, activated with <CTRL> P. It is possible to select which compiler to run, although this can only be done in the setup program. The file extension enables Brief to identify which compiler to invoke when <ALT> F10 is pressed (ie a .C file is compiled with CL, a .asm file is assembled with MASM). Brief's support for C, provides the programmer with a template facility (like Ed's) to reduce typing. Unlike Ed, this only requires a single character followed by a space to invoke the template macro. For instance the key sequence <i> <space> produces the following:

```
if ()
```

One of the cleverest features of Brief is its ability to work with third-party software. Brief has built-in support for the PVCS, TLib and Sourcer's Apprentice version control system, although I was not able to test this personally. There is also support for the Microsoft Programmer's Workbench (PWB) and Microsoft's Quick Help (supplied with Microsoft C V6.0). Quick Help provides context-sensitive Help on C syntax and standard functions. It's very neat.

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System Science (071 8331022)	£45	-	£175	£195	£189

(Please note that all prices include p&p in the UK, but not VAT)

Figure 5 - Editor Prices

You only have to run Brief's qh macro to get help on a keyword/function at the current cursor position (see Figure 3). All of these features make Brief a brilliant editor, albeit with a hefty price-tag.

PVCS Professional Editor

As is the case with Epsilon and Brief, the PVCS Professional Editor (also called the Sage Professional Editor - SPE) is available under DOS and OS/2.

SPE provides all the usual cursor controls and editing commands, although it doesn't provide a column copy facility. There is a menu-bar which is activated with <CTRL> H, and a status bar that shows the filename. There is a Help system which can be activated from the menu or by pressing <F10>. Although not context-sensitive, the online documentation is well presented. Help is arranged as two scrollable windows placed side-by-side. The leftmost window contains a list of SPE's commands. As you scroll down this window, the right window displays documentation on each topic.

There is a DOS window, like Epsilon's, although it is not concurrent. The DOS windows uses only 24 KB of memory, so you should be able to run a compiler inside it. SPE will even run Windows Enhanced mode from within the DOS window. SPE also has a DOS shell, and it is able to compile a buffer from within the editor. On typing <ALT>F10, SPE pops up a window containing an editable commandline.

When compiling a buffer, SPE produces an error window and positions the cursor on the line containing the first error. It is possible to step through each error in turn, however SPE also enables you to quickly move to a particular error by scrolling down the error window.

SPE provides built-in support for C. It is able to produce C-style indentation and there is also a template facility. SPE can emulate Brief, vi, WordStar and MsWord and there is also a keyboard macro recorder. There's a built-in ASCII table which lets you embed any ASCII character into your text by entering its ASCII value (<ALT> + number from numerical key-pad is quicker if you know what you're doing). SPE is the only editor in this article that supports multiple overlapping windows. In addition to being able to create windows side-by-side, SPE allows windows to be placed on top of each other (see Figure 4). When you have several files opened at the same time, arranging each buffer as an overlapping window provides a far more intuitive way of editing multiple files than using a single window with a buffer-list. It also uses less screen space than a tiled-window arrangement - at least you won't have to resort to excessive scrolling in order to do anything useful.

Conclusion

Choice of editor is almost always influenced by past experienced. If you're a die-hard fan of WordStar, I won't waste space convincing you that there are better things available. However, most of the editors in this article provide emulations for the more popular text editors (including WordStar). So which one should you buy? Well, it all depends on what you intend to use it for. Qedit is an ideal replacement for MS DOS 5.0's `edit` - it provides far more functionality and it doesn't crash. Epsilon offers a terse, UNIX-style environment and is available under UNIX as well as DOS and OS/2. Brief and SPE are similar products, targeted at the same market (ie C programmer's looking for a high-end professional editor). My favourite? It has to be Ed. It offers many of the features found on Brief or SPE - but at almost half the price.

EXE

QEdit, Epsilon, Brief and the PVCS Professional Editor were supplied by System Science on 071 8331022. Ed was supplied by QBS on 081 9944842.

Wasting our time

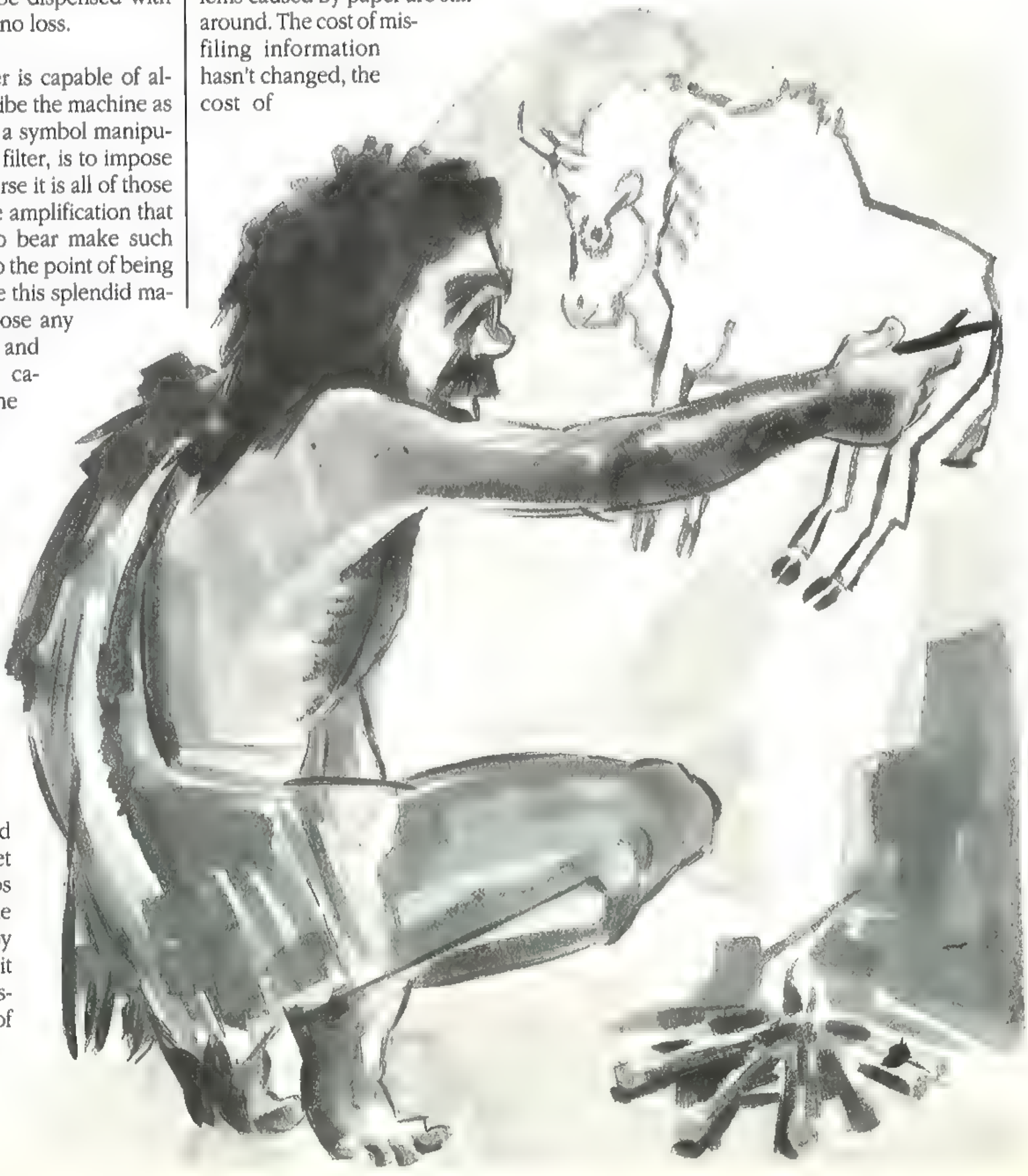
Why do we buy computers and write programs? Jules thought he knew, but is not so sure.

It was during an argument when the thought struck me. It was such a surprise that I conceded the point of the argument, in order to go away to consider it! The thought was this; computers don't actually do anything. I don't mean this in a literary or figurative sense, nor am I talking about abstract philosophy. I mean it quite literally; most computers could be dispensed with entirely with practically no loss.

In principle, a computer is capable of almost anything. To describe the machine as a bunch of switches, or a symbol manipulator, or an information filter, is to impose restrictions on it. Of course it is all of those things, but the immense amplification that computers can bring to bear make such descriptions simplistic to the point of being misleading. We can take this splendid machine, and we can impose any concept on it we wish, and the computer will be capable of responding to the imposition and offering its user a clean, effective metaphor.

Most programs which have been written use the same metaphor - paper. I suppose this makes sense - everyone who can type can read, and most of what we read is made of paper. When computers were first manufactured in the '50s they were set to work automating jobs which were being done perfectly adequately by armies of clerks, albeit slowly. Nobody questioned why the armies of clerks were necessary, and nobody questioned that the same work needed doing on the computer. It wasn't until Marks and Spencer worked out how much it cost to misfile a piece of paper that they decided they could throw some of it out - 120 tons of it in fact!

As long as computers are automating work that originated on paper, all the old problems caused by paper are still around. The cost of misfiling information hasn't changed, the cost of getting the data onto the forms in the computer hasn't changed, and the cost of someone wading through acres of figures hasn't changed either. The cost of processing the data has decreased, of course, which has permitted yet more paper to be produced. Tasks which used to use paper out of necessity, like fin-

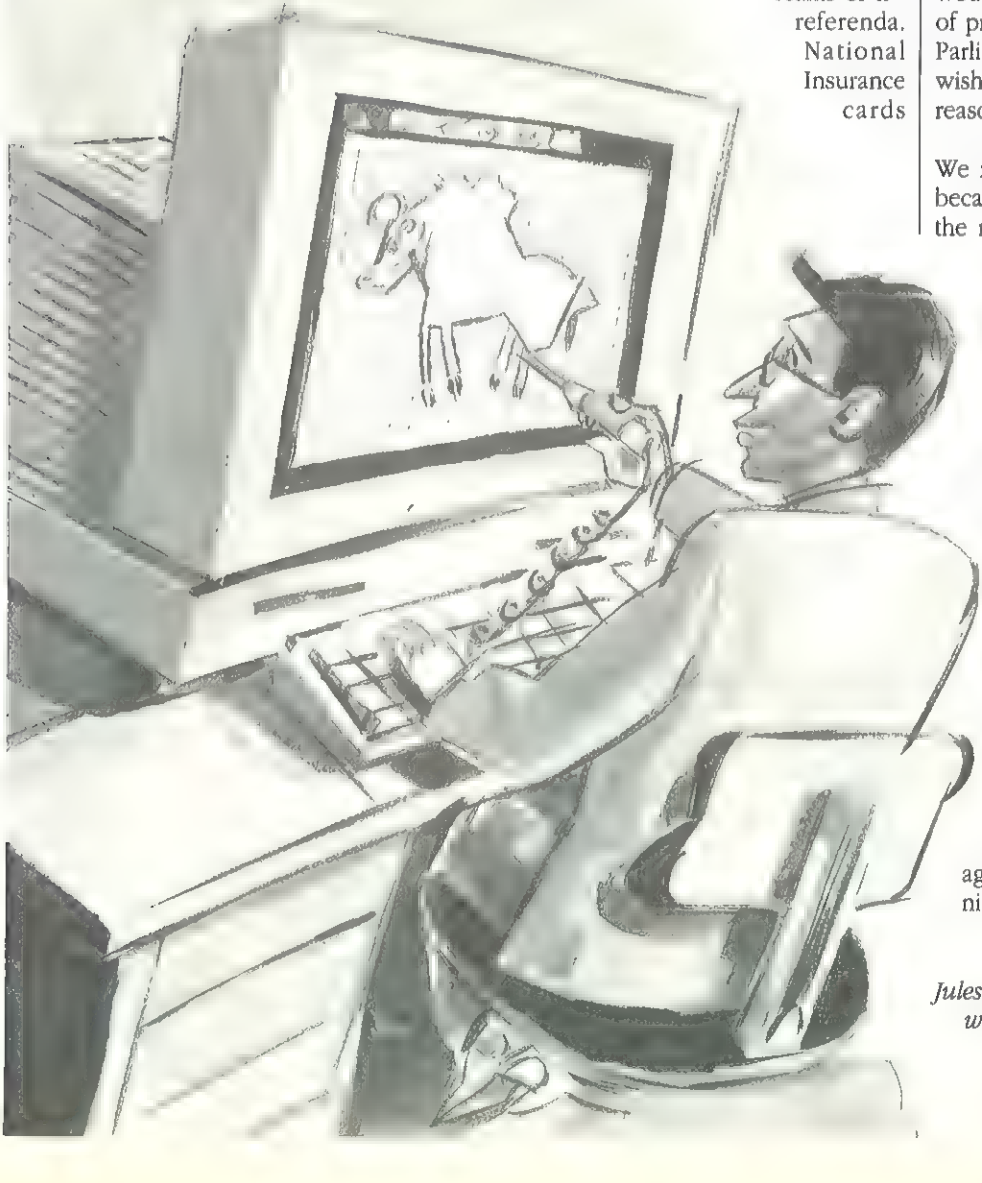


ance, CAD, and graphics, instead of being freed by computers, have been computerised monolithically, paper and all. Now, the wonderful world of Windows is opening up before us - here is computing like you've never seen it before. Ha! What is the central metaphor of windowing systems? Paper, that's what!

'Aha!' I hear you say, 'but most computers are made for business, and business needs accurate records, doesn't it? Paper is good for that!' Well, yes and no. Most people who run businesses do so because they want to build something, not because they like paperwork. I have yet to meet an executive who doesn't complain about his paperwork, no matter how many computers and secretaries he is given. The only reason an exec needs to know his company's turnover correct to three pence is because the taxman demands it, but whv does the taxman need such precision? The exec doesn't work out his buying strategy to the nearest three pence, does he? Why isn't 1% precision good enough all round?

Consider, as an alternative, the spectacular strides which have been made in musical instrument design. One can get cheap machines which can synthesise practically any noise one can imagine, and the proof is that often synthetic instruments sound better than their acoustic counterparts. There are computers into which you can hum a tune, and they can, in real time, figure out harmonies and rhythms to back you up. Almost every band now comprises a guitarist, a drummer, and a programmer! Furthermore, these machines are usable by musicians - their buttons and knobs are annotated in terms a musician can understand.

For another example, let us pursue the idea of removing paper from a process which traditionally demands reams of it - referenda. National Insurance cards are now plastic, with a magnetic stripe on the back. Suppose every post office in the country is equipped with a terminal, into which you insert your card, and are shown a list of the issues being debated in parliament. Instead of politicians having to guess whether we want to be European, or whether we want a bill of rights, or whether we want to re-introduce Sunday trading, we can tell them. The computers could keep a record of what issues a citizen has voted on (though probably not the vote he has cast) to avoid repetitions. We could build the first real democracy the world has ever seen!



This is looking good, let's follow it further. One could subscribe from one's telephone, so it is not necessary to stand in queues. Instead of seeing politicians rubbishing each other on the telly, we could augment the system with statements of position from interested parties. One could even contribute one's own statement, which would become more easily accessible as more people looked at it. A citizen would be able to introduce his own bill, which again, would work its way up the system to a place of prominence if interest in it demanded. Parliament would then have to follow the wishes of the people, or else give a good reason why it won't.

We need representatives at the moment, because calling a referendum - the paper, the manpower, and the officialdom - all costs money. Here is a system which could slash those costs, and improve the service to boot, because what referenda are for, in the final analysis, is to take decisions. The engineering is almost trivial, and the technology is tried and tested.

Returning to my original assertion, it seems to me we are wasting some wonderful technology. Computers are not new (they we first built in 1943) and are largely mature by now. We have enough knowledge and skill now to build things to pretty good precision (which is good enough), and the only thing which is blocking the technology from being really useful is conservatism and lack of imagination. I'm afraid most of us are spinning our wheels.

EXE

Jules May is a consultant who feels naked without a computer in front of him, and is currently trying to find the time to write lots of new programs. He can be contacted on 0707 44185, or on CIX as jules.

Segments From Hell

Once you've navigated the treacherous waters of the memory management 'River Styx', you too can give your DLLs a touch of class. Laine Stump puts a C++ class library into a Windows DLL.

Windows Dynamic Link Libraries (DLLs) seem to be the perfect package for implementing and distributing class libraries; rather than bloating all those EXE files with the same library code, you can build a DLL and call the same code from any EXE. This not only saves space on disk, it (more importantly) saves memory at runtime.

But putting your handcrafted classes into a DLL isn't as simple as just recompiling. Besides making sure that the proper names are exported from the DLL and imported to the application (APP), you must take care to avoid problems with the 'Dual Heap' structure of the DLL-APP pair - not only are the code of the DLL and APP in separate segments, they each have a separate automatic data segment (heap, or DS) as well. (Figure 1 shows a simplistic picture of the segments of a DLL and two APPs; note that an APP's stack is in the same segment as its heap, while a DLL has no stack - it borrows the stack of the calling APP).

With all these complications, it's not difficult to construct a program where inheritance, virtual functions, and static data members, (among other features) don't work at all properly.

As usual, the explanations and examples included with compiler packages do not exercise all these capabilities (BC++'s DLL example had a class, but did not derive any other class from it; Zortech's DLL example was written in straight C), so I set to explore the subject by creating my own example program, with APP classes derived from DLL classes, static data members, and virtual functions called both from the APP and from the DLL. Along the way, I recorded the pitfalls, problems, hints, and solutions I found, and present them here so that the rest of you won't have to go through the same torture (fun torture though it was).

Piece

The example I will use to help in my explanations is a simple class called Piece. A Piece is any object that can be displayed in a window. The base class has functions for hiding, showing, and moving a Piece, as well as a virtual function called Paint() which is redefined for each derived class. Piece resides in a DLL, along with a derived class called cRectangle. PIECE.DLL needs PIECE.CPP, PIECE. These files are shown in Figures 3, 4 and 5.

The main program, PieceTst (see Figures 6 and 7), derives a second class, cEllipse, from Piece, and creates three cRectangles and two cEllipses which it stores in an array of Piece *. WndProc works together with members of Piece to allow the user to drag these pieces around the screen with the mouse. Except for Piece and its derivatives, the rest of the program is in standard C style, as I didn't want to clutter up the discussion with more than one set of classes. Ideally the Pieces would be stored in some type of DisplayList, and the windows and even the application itself would also be instances of C++ classes. I leave those as exercises for the hapless reader.

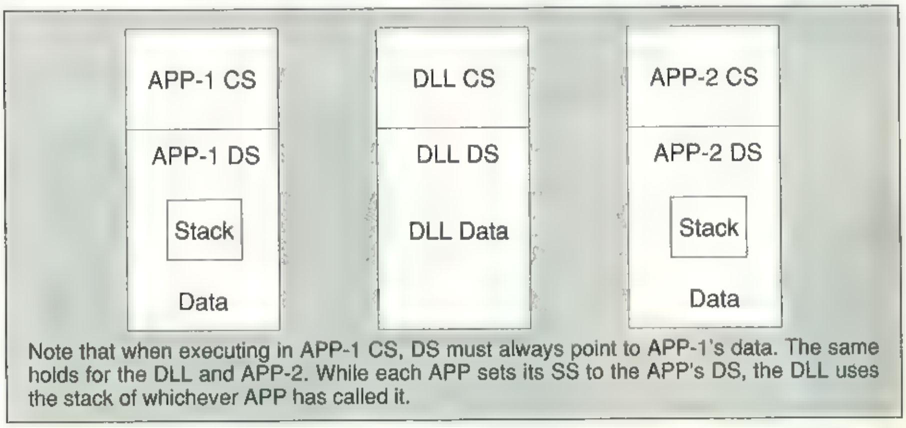
PIECETST.EXE is created from PIECETST.CPP, PIECE.H, PIECETST.DEF, PIECE.LIB (created by running IMPLIB on PIECE.DLL) and PIECETST.RES.

I developed and tested Piece and PieceTst using Zortech C++ v3.0r4 (ZTC); the necessary commands to compile are in Figure 2 (M.BAT). Only small changes should be needed for BC++ v3.0 - different compiler switches and a slightly different method of exporting functions from the DLL.

EXPORTing from the DLL

The names of all functions in a DLL which will be called from APPs and other DLLs must be available for load-time linking. Windows calls this 'exporting' the function. The client program then 'imports' the function to use it.

You can export a function in either of two ways: list it in the EXPORTS section of the DLL's .DEF file, or tag the function definition with the keyword _export. The former method makes for impressive looking lists, but can be quite awkward, as the name listed in the .DEF file must be the function's mangled name.



Note that when executing in APP-1 CS, DS must always point to APP-1's data. The same holds for the DLL and APP-2. While each APP sets its SS to the APP's DS, the DLL uses the stack of whichever APP has called it.

Figure 1 - Segments of two APPs and a DLL.

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I used the second method in Piece. Notice that each function of the class is preceded by the word EXPORT (#defined to be _export if compiling for a DLL, or null if compiling for a normal static link). The compiler and linker work together to make the mangled name of these functions available for export. Much easier.

You will notice that two types of member functions are not exported with _export: inline functions and destructors. Inline functions are not listed as _export because their code does not exist in the DLL anyway; the function isn't imported, but merely inserted into the APP anywhere it is 'called'.

I couldn't use _export on destructors because of a bug in the current release of ZTC which flags such attempts as an error. Until Zortech makes another release, we're stuck figuring out the name of the destructor and listing it in EXPORTS in the .DEF file (see PIECETST.DEF). Find this name by looking in the linker's .MAP file - destructors always have the name

```
___dt__#classnameFv
```

where # is the number of characters in the class name.

Seasoned Windows programmers should note that the requirement of exporting destructors via the .DEF file means we can't use the 'reduced prolog' compiler switch (-W2) as it only allows functions marked with _export in the source to actually be exported. I used -W1 (full prolog for all far functions) in my tests.

No data members are exported in any manner, as instance data can be located via the this pointer, while static data cannot be accessed directly from outside the DLL anyway, as we'll see momentarily.

IMPORTing to the APP

Once a class's member functions have been exported, the APP must import them in order to use the class. There are two ways of accomplishing this as well: listing the desired function names in the IMPORTS section of the APP's .DEF file (in mangled form, of course), or creating an 'Import Library' from the DLL. As we all hate dealing with mangled member function names, we will again choose the second method, which turns out to be simple to the point of disgusting - run IMPLIB on the DLL, then add the produced .LIB file to the compile command for the APP. Don't forget to rerun IMPLIB any time you add or remove a function from the DLL.

Memory Model

Windows is a weird duck in terms of memory models. The freewheeling cauldron of moveable data segments and discardable code segments is frightening if you stop to think. A remnant of its real mode past, Windows attempts to do 'big boy' memory management tasks purely in software. For this to work correctly, well behaved programs should allow as many of their segments as possible to be moved at almost any instant. You can't allow this and have far pointers at the same time, hence the popularity of Medium model (far code, near data) in Windows programs. Large model is allowed, you just have to lock all your data segments in place (and face lynching by the Charles Petzold fan club).

```
    ztc -mlw -W1 -o -D__DLL__ piece piece.def piecetst.res
    implib piece.lib piece.dll
    ztc -ml -W3 -o piecetst piecetst.def piecetst.res piece.lib
```

Figure 2 - M.BAT - compile command for PIECE and PIECETST

```
#include <windows.h>


#ifdef __DLL__
#define EXPORT  export
#else
#define EXPORT
#endif

enum TIMES {IMMED, DELAY};

class Piece
{ // Graphics "Piece" base class
  // static member data
  static HWND  hCurWnd; // cur. window
  static HDC   hDC;  // device context
  static PRECT Inv;  // invalid region
protected:
  // instance member data
  HWND hWnd; // owner window
  RECT bnd;  // bounding rectangle
  DWORD color;
  WORD visible;


  // "real" paint - defined by all,
  // but only called by other members
  virtual void EXPORT Paint() = 0;
public:
  static void EXPORT
   SetContext(HWND hw, HDC h, PRECT i);
  HDC EXPORT GethDC();


  EXPORT Piece(HWND hw,
               int x, int y, DWORD c);
  virtual ~Piece();
  virtual void EXPORT ReDraw();


  int  GetX() { return bnd.left; }
  int  GetY() { return bnd.top; }
  int  EXPORT Contains(int x, int y);
  WORD EXPORT Hide(WORD when = DELAY);
  WORD EXPORT Show(WORD when = DELAY);
  void EXPORT MoveAbs(int x, int y);
};


// cRectangle - DLL class from Piece
class cRectangle : public Piece
{
public:
  EXPORT cRectangle(HWND hw,
         int x, int y, int dx, int dy,
                             DWORD color);
  ~cRectangle();
  void EXPORT Paint();
};
```

Figure 3 - PIECE.H

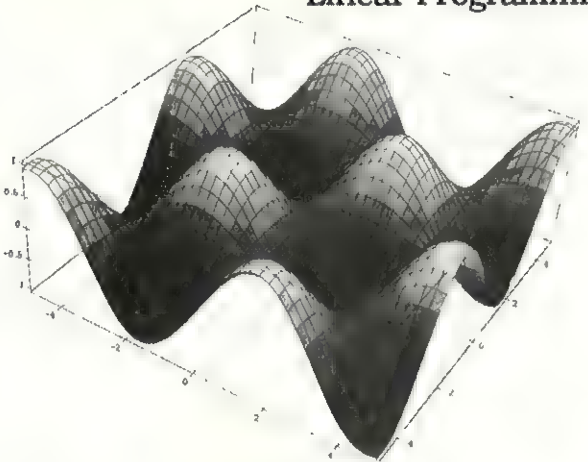
Unfortunately, if you want classes in a DLL, you must compile everything with Large model. I first resisted the idea, but when I learned that even the BC++ OWL library DLLs can only be used with Large model, I resigned myself to fate, and comforted my soul by repeatedly chanting the final section of the Memory Management chapter in Petzold's Windows book, ignoring the part earlier on that referred to Large programs as 'pigs'.

Although there are many, I will tell you two reasons why any program having classes in a DLL must be compiled as Large model (sorry, Charlie). The cause of both is that the DS of the APP and the DLL are separate, and an object could be located in either one:

1) To allow access to objects in either DS, the this pointer of all member functions must be far. It is reasonable for a member function to call Windows, and every Windows programmer knows that Windows is free to move any nonlocked segments any time Windows is called. The result is that the this pointer could be invalid upon return from the call. Besides, Zortech only allows this to be far in Compact and Large model (you can't explicitly create a far object in Medium or Small model).

2) Each object has a pointer to a Virtual Method Table (VMT) which is usually in the DS of the program which created the object. This pointer is used to call the proper virtual function for an object. As long as you are calling from the same 'side' of the DLL-APP boundary which allocated the space for the object, the VMT can be found with a near pointer (eg calling ReDraw() for a cEllipse from within the APP). But, if you are calling a virtual function for an object that was allocated from the other side, you need a far pointer to find the VMT (eg calling ReDraw() for a cRectangle from the APP, or calling Paint() for a cEllipse from the DLL). Again ZTC only allows far VMT pointers when compiling with far data models (Compact and Large).

BC++ goes even further - VMT pointers are near in all models unless you 1) set a compiler option to put them in the code segment, or 2) declare the class as huge. Option 1) requires that code segments, like data, be locked and nondiscardable, while option 2) would not work properly with BC++ v2.0 (I couldn't derive a huge class from an _export base class).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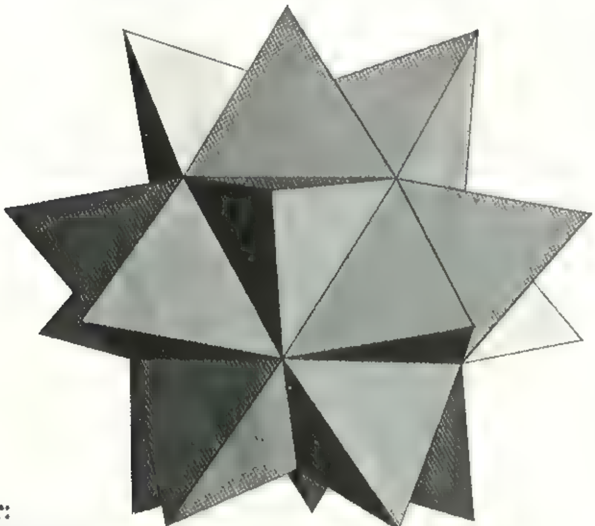

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Happily, if you run Windows in Standard (286 protected) or Enhanced (386 protected) mode, even 'locked' segments are moveable. After moving the data to a new segment, Windows just fixes up the selector table so that the same selector points to the new segment. Your program can use far pointers with wild abandon, while Windows efficiently scoots memory around.

Static Data Members

Remember that the DLL has a different DS from the APP. Static data of the base class is put in the DLL's DS. In order to access this data, you must be executing in the DLL (the DS register is set to point to the DLL's DS by the DLL function's prolog). Don't try to use static members in inline functions, as DS will be incorrect. Also, make sure that the user of your class can't do it either. The only way to guarantee this is to make all the static data private to the base class, and write functions to get and set the values. That's what I've done for `Piece` - all three static members are private, and I've defined functions for manipulating them (`SetContext()`, `GethDC()`). Remember, these functions can't be inline!

Member Functions

Functions that access only instance data can safely be inlined. `GetX()` and `GetY()` are examples of such functions.

Any member function that requires access to data in the DLL's DS should not be inlined, though. This includes functions which call the standard C library, or use any global data declared in the DLL.

Although you may think that your constructors and destructors only use instance data, they actually have secret implied calls to `new` and `delete`. Rather than calling `new` directly when you allocate an object dynamically, both ZTC and BC++ generate code which calls the constructor with a `NULL this` pointer. The constructor checks for this condition, and accordingly calls `new` if necessary. When a destructor is called, a flag is set if the data was dynamically allocated. If so, `delete` is called. If the constructor and destructor are defined in the DLL, the object will live in the DLL's heap, even though it was created by the APP.

Therefore, either all or (preferably) none of the constructors and destructors should be inline; they should all execute either in the DLL or in the APP to avoid situations where memory is allocated from one heap and released to another. `Piece` defines all constructors and destructors as non-inline.

Which Heap?

As mentioned above, every call to `new` from a constructor defined in the DLL gets memory from the DLL's heap. If several programs are using the DLL, it could exhaust the local heap (64 KB) quickly. To allow allocating more than 64 KB, you can redefine `new` and `delete` in the DLL, as I have at the top of PIECE.CPP. I simply defined `new` to allocate a fixed block of memory from Windows' Global Heap. Using the Global Heap is slower than the normal Local Heap, but you can allocate as much memory as you like, up to the limit of your RAM, or your swap file size.

I also redefined `new` and `delete` in the APP (PIECETST.CPP) to use the standard Windows Local Heap. The ZTC libraries do their own heap management in Compact and Large models under Windows, and I encountered bugs when running multiple instances of the same program using Zortech's heap management. Redefining `new` and `delete` solved the problem.

```
// #define   DLL   // to use as DLL

#include "Piece.h" // includes windows.h

#ifdef   DLL
int FAR PASCAL LibMain
      ( HANDLE hInst, WORD wDS,
        WORD wHeapSz, LPSTR lpszCL )
{ return 1; }

int FAR PASCAL WEP ( int bSystemExit )
{ return 1; }
//
#include  <stdlib.h> // to define size_t
// use Windows' Global Heap
void * operator new(size_t siz)
{
  return (void*)
  MAKELONG(0, GlobalAlloc(GPTR,siz));
}
void operator delete(void *obj)
{
  GlobalFree( (GLOBALHANDLE)
                LOWORD((LONG) obj) );
}

#endif
HWND Piece::hCurWnd = 0;
HDC Piece::hDC = 0;
PRECT Piece::Inv = 0;

void EXPORT Piece::SetContext
               (HWND hw, HDC h, PRECT i)
{  // set static data for Painting
  hCurWnd = hw;
  hDC = h;
  Inv = i;
}

// short, but *must not* be inline
HDC EXPORT Piece::GethDC()
{ return hDC; }

EXPORT Piece::Piece(HWND hw, int x,
                    int y, DWORD c)
{
  hWnd = hw;
  bnd.left = x; bnd.top = y;
  color = c;
  visible = 0;
}

// note:  Piece exported by DEF file
Piece::~Piece()
{ if (visible) Hide(DELAY); }

void EXPORT Piece::ReDraw()
{ // call paint if in Inv
  RECT r;
  if ( (hCurWnd == hWnd)  && visible &&
      IntersectRect(&r, &bnd, Inv) )
  {  // set brush, paint, reset brush
    HBRUSH hb, ohb;
    hb = CreateSolidBrush(color);
    ohb = SelectObject(hDC, hb);
    Paint(); // virtual, possibly in APP
    SelectObject(hDC, ohb);
    DeleteObject(hb);
  }
}

int EXPORT Piece::Contains(int x, int y)
{  // checks if (x,y) is inside Piece
  POINT p; p.x = x; p.y = y;
  return PtInRect(&bnd, p);
}

WORD EXPORT Piece::Hide(WORD when)
{  // hide this piece
  WORD was = visible;
  visible = 0;
  InvalidateRect(hWnd, &bnd, 1);
  if (when == IMMED)
    UpdateWindow(hWnd);
  return was;
}

WORD EXPORT Piece::Show(WORD when)
{  // unhide this piece
  WORD was = visible;
  visible = 1;
  InvalidateRect(hWnd, &bnd, 0);
  if (when == IMMED)
    UpdateWindow(hWnd);
  return was;
}

void EXPORT Piece::MoveAbs(int x, int y)
{     move upper left of piece to x,y
  WORD wasvisible = Hide(IMMED);
  bnd.right  = x+(bnd.right -bnd.left);
  bnd.bottom = y+(bnd.bottom-bnd.top);
  bnd.left   x; bnd.top = y;
  if (wasvisible) Show(DELAY);
}

// ** member functions of cRectangle

EXPORT cRectangle::cRectangle
         (HWND hw, int x,  int y,
          int dx, int dy, DWORD color)
  : Piece(hw, x, y, color)
{  // set rectangle to be drawn
  bnd.right  = x + dx;
  bnd.bottom = y + dy;
  Show(DELAY);
}

// declare destructor to ensure delete
// is called from proper context
// (inside DLL, not APP)
cRectangle::~cRectangle() {}

void EXPORT cRectangle::Paint()
{ // paint this Rectangle
  // color has been set by ReDraw()

  Rectangle(GethDC(), bnd.left, bnd.top,
                 bnd.right, bnd.bottom);
}
```

Figure 4 - PIECE.CPP

```
LIBRARY     PIECE
DESCRIPTION 'DLL for Piece class'
EXETYPE     WINDOWS
CODE        PRELOAD MOVEABLE DISCARDABLE

DATA        PRELOAD SINGLE FIXED
HEAPSIZE    1024
EXPORTS     __dt__5PieceFv
            __dt__10cRectangleFv
```

Figure 5 - PIECE.DEF

Remember, the location of object allocation is decided by where the code of the constructor and destructor reside, NOT where you call `new` and `delete`. Since `cRectangle`'s constructor and destructor are in the DLL, `cRectangles` are allocated on the Global Heap, while `cEllipses` (constructor and destructor in the APP) are allocated on the APP's Local Heap.

Virtual Functions and DS

Here's where it starts to get fun. Remember that when executing in the DLL, DS must be set to the DLL's DS, while in the APP it must be set to the APP's DS. As long as you don't cross the DLL-APP boundary, DS will be set properly, but any function that can be called from the other side (APP->DLL or DLL->APP) must have instructions to save the calling DS and point DS to the called procedure's heap. In terms of Figure 1, any crossing of the borders between CSes must be accompanied by an appropriate change to DS. Crossing from APP->DLL happens any time a base class member function is called. DLL->APP occurs when a function in the DLL calls a virtual function of a derived class (eg `Piece::ReDraw()` calls `cEllipse::Paint()`).

```
// PieceTst.cpp - test the Piece class
// and show how it should be used.
#include "piece.h" // includes windows.h

[illegible]
#include  <stdlib.h>  // defines size_t
   use Windows' Local Heap
void * operator new(size_t siz)
{
 return (void*) (void NEAR*)
   LocalAlloc(LPTR, siz);
}
void operator delete(void *obj)
{
  LocalFree( (LOCALHANDLE)
              LOWORD(obj) );
}
[illegible]                         ////////
   ** cEllipse - APP class from Piece

class cEllipse : public Piece
{
public:
  cEllipse(HWND hw, int x, int y,
           int dx, int dy, DWORD color);
   ~cEllipse();
  void Paint();
};

cEllipse::cEllipse(HWND hw, int x, int y,
              int dx, int dy, DWORD color)
: Piece(hw, x, y, color)
{  // set rectangle to be drawn
  bnd.right  = x + dx;
  bnd.bottom = y + dy;
  Show(DELAY);
}

cEllipse::~cEllipse()
{     // implicit call to Piece::~Piece()
}     // cEllipse::~cEllipse()

void cEllipse::Paint()
{     // call *only* from Piece::ReDraw()
  Ellipse(GethDC(), bnd.left, bnd.top,
                  bnd.right, bnd.bottom);
}
[illegible]

Piece *pieces[5]; // array of 5 Pieces
char szAppName[] = "PieceTest";

long FAR PASCAL  export
     WndProc(HWND, WORD, WORD, LONG);

int FAR PASCAL
WinMain(HANDLE hInst, HANDLE hPrevInst,
        LPSTR lpszCmdLine, int nCmdShow)
{
  HWND hWnd;
  MSG  msg;
  WNDCLASS wc;
  if (!hPrevInst)
  {
    wc.style  = CS HREDRAW | CS VREDRAW;
    wc.lpfnWndProc    = WndProc;
    wc.cbClsExtra     = 0;
    wc.cbWndExtra     = 0;
    wc.hInstance      = hInst;
    wc.hIcon          = LoadIcon(NULL,
                        IDI_APPLICATION);
    wc.hCursor        = LoadCursor(NULL,
                             IDC ARROW);
    wc.hbrBackground = GetStockObject
                        (WHITE BRUSH);
    wc.lpszMenuName  = NULL;
    wc.lpszClassName = szAppName;
    RegisterClass(&wc);
  }

  hWnd = CreateWindow(szAppName,
        "Testing Pieces",
        WS OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT,
        CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInst, NULL       );
  ShowWindow(hWnd, nCmdShow);
  UpdateWindow(hWnd);

  while (GetMessage(&msg, NULL, 0, 0))
  {
    TranslateMessage(&msg);
    DispatchMessage(&msg);
  }
  return msg.wParam;
}

long FAR PASCAL  export
WndProc (HWND hWnd, WORD msg,
         WORD wParam, LONG lParam)
{
  int ct;
  static curpc = -1, npc = 5;
  static xofs, yofs;
  switch (msg)
  {
   case WM CREATE:
     pieces[0] = new cRectangle(hWnd,
      20, 20, 150, 150, RGB(255,0,0));
     pieces[1] = new cRectangle(hWnd,
      40, 40,  80,  50, RGB(0,0,255));
     pieces[2] = new cRectangle(hWnd,
      70, 95, 120, 180, RGB(25,10,50));
     pieces[3] = new cEllipse(hWnd,
      200,100, 60, 90, RGB(255,255,0));
     pieces[4] = new cEllipse(hWnd,
      150,30, 120, 100,RGB(0,255,255));
     return 0;

   case WM PAINT:
     PAINTSTRUCT ps;
     HDC hDC = BeginPaint(hWnd, &ps);
     Piece::SetContext(hWnd, hDC,
                        &ps.rcPaint);
     for (int ct = 0; ct < npc; ct++)
       pieces[ct]->ReDraw();
     EndPaint(hWnd, &ps);
     return 0;

   case WM_MOUSEMOVE:
     if ((wParam & MK LBUTTON)
                     && (curpc != -1))
       pieces[curpc]->MoveAbs(
                   LOWORD(lParam)-xofs,
                   HIWORD(lParam)-yofs);
     return 0;

   case WM LBUTTONDOWN:
     curpc = -1;
     for (ct = npc-1; ct >= 0; ct--)
       if (pieces[ct]->Contains(
                        LOWORD(lParam),
                        HIWORD(lParam)))
       {
         curpc = ct;
         xofs = LOWORD(lParam)
              - pieces[ct]->GetX();
         yofs = HIWORD(lParam)
              - pieces[ct]->GetY();
         break;
       }
     return 0;

   case WM_RBUTTONDOWN:
     SendMessage(hWnd, WM LBUTTONDOWN,
                     wParam, lParam);
     if (curpc != -1)
     {
       npc--;
       delete pieces[curpc];
       for (ct = curpc; ct < npc; ct++)
         pieces[ct] = pieces[ct+1];
       curpc = -1;
     }
     return 0;

   case WM DESTROY:
     for (ct = 0; ct < npc; ct++)
       delete pieces[ct];
     PostQuitMessage(0);
     return 0;
  }  // switch (msg)
  return DefWindowProc(hWnd, msg,
                        wParam, lParam);
}
```

Figure 6 - PIECETST.CPP

DLL functions have code in the function prolog which saves the DS of the caller and sets DS to point to the DLL:

```
mov  AX, xxxx ;DLL's DS
...
push DS
mov  DS, AX
```

Before any statements of the DLL function are executed, DS is pointed to the DLL's heap. As there is only one instance of any DLL (multiple APPs use the same DLL instance), this method of loading a constant value works.

The same method won't work for an APP, though, as there can be many instances of the same APP, and each has it's own Local Heap (and DS). Therefore DS can't be loaded by a prolog to the function as was done in the DLL. Instead, each instance of an APP function which is exported (callable from outside the APP), is called through an 'Instance Thunk':

```
mov AX, xxxx ;this instance DS
jmp xxxx:yyyy;jump to function
```

The function begins by pushing DS, and setting DS to the value passed in AX. Each instance of an APP has it's own Instance Thunks.

The problem is that except for WindowProcs, Instance Thunks are not created automatically, they must be created by the programmer calling the Windows function `MakeProcInstance()`, which returns a pointer to the Instance Thunk, used thereafter to call the function. As the programmer doesn't have direct access to the Virtual Method Table (containing pointers to the virtual functions), this method of fixing DS is impractical for virtual functions.

All is not lost, however, if you remember that the Stack Segment (SS) is always pointing to the current APP's stack, even when you are executing in the DLL. By definition, an APP's SS is equivalent to its DS. When a function in the APP (in particular, a virtual member function) is called from the DLL, its prolog can simply load DS from SS (after saving the calling DS, of course):

(Continued on page 66)

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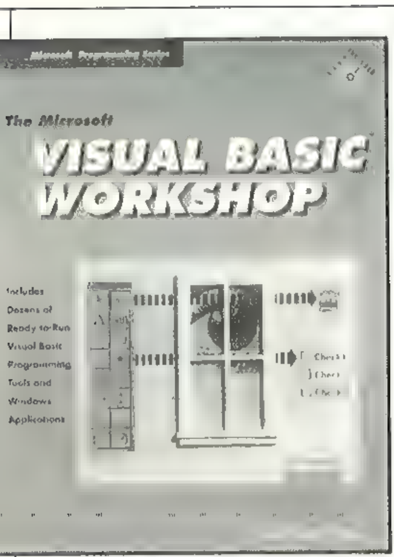
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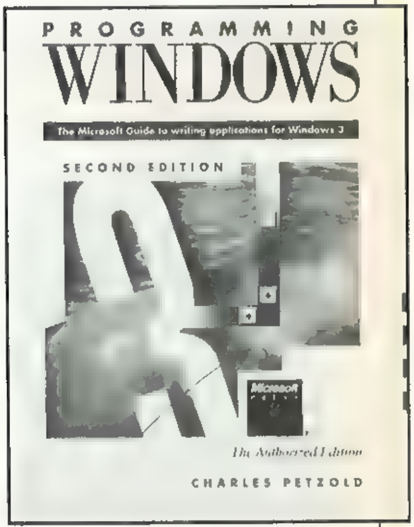

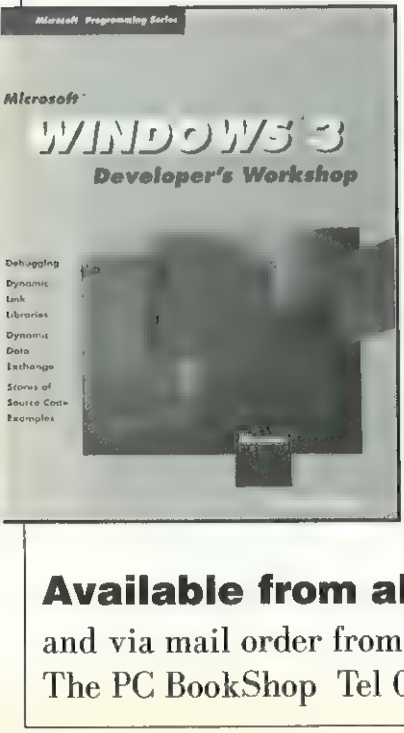

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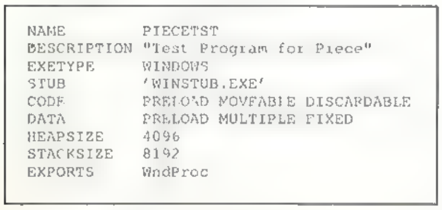
```
mov  AX, SS ;APP's DS
...
push DS
mov  DS, AX
```

In contrast to loading DS with a constant value (as done for DLLs), loading from SS will work with multiple instances of an APP.

Luckily, ZTC and BC++ both have a compiler switch that causes all far functions to load DS from SS as shown above. Use -W3 for ZTC, and -WS for BC++. As all far functions are considered exportable when using this switch, you don't have to mark the functions as `_export`.

Review

In brief, to put your class into a Windows DLL:



```
NAME        PIECETST
DESCRIPTION "Test Program for Piece"
EXETYPE     WINDOWS
STUB        'WINSTUB.EXE'
CODE        PRELOAD MOVEABLE DISCARDABLE
DATA        PRELOAD MULTIPLE FIXED
HEAPSIZE    4096
STACKSIZE   8192
EXPORTS     WndProc
```

Figure 7 - PIECETST.DEF

1) Use Large Memory Model - declare all Data Segments as FIXED.
2) Declare nonline members as `_export`.
3) Put destructors' mangled names in EXPORTS of the DLL's .DEF file.
4) Do not access static data or library functions from inline functions.
5) Make all static data members private to the DLL, and give access to them through (non-inline) member functions if necessary.
6) Do not make constructors or destructors inline.
7) Redefine `new` and `delete` in the DLL if you will need >64 KB of space for objects of classes defined in the DLL.
8) Compile the APP with -W3 (ZTC) or -WS (BC++) so that DS is loaded from SS on entry to all far functions.
9) Don't forget the fire extinguisher.

Conclusion

Although a price must be paid to put C++ classes into Windows DLLs, notably the requirement of using Large model and the necessity to be careful about static data and virtual functions, it is worth the expense. EXE files are smaller, and memory usage is potentially less (if several APPs use the same DLL).

Due to data segments being locked, programs which use these DLLs will run in a degraded state in Real mode Windows, but will show little performance penalty in Standard and Enhanced mode.

EXE

Laine Stump has been threatening to get into Windows programming for at least two years, but has just managed to get off his duff in the last six months. His desk is now several inches deep in purple and blue manuals, dirty dishes, and half-eaten cheese sandwiches.

As usual, he can be reached via the PC Tech BBS at (0101-612-345-4656, evenings, US time) or by post at: Bilkent University, Lojmanlari 3/9, 06533 Bilkent / Ankara, TURKEY.

The code accompanying this article is available on disk. Send a blank formatted floppy disk to the Editor, following the instructions given on Page 1, column 1. Mark your envelopes 'CPPDLL'.

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Gyre and Gimble

...are Julian Bucknall's words for the action of Turbo Pascal's overlay manager, in the first of a new column devoted to !C (= 'not C', geddit?) programming.

There are two alternative beginnings to this article: choose the one you believe (a bit like *The French Lieutenant's Woman* in reverse).

The first was when I was recently composing an internal memo on how Turbo Pascal V6.0 used memory to overlay my application's code. I blithely wrote something like '...and the code is switched in from EMS in chunks of 2 KB to 5 KB...', when I stopped. How did I know how big my overlaid units were? With Turbo Pascal's smart linker stripping out unused procedures, functions and methods the code size reported by TPC (the command line compiler) was no help. The MAP file gave me information I didn't believe (the overlaid units looked miles too small); the manual is silent on the subject.

The second story was a program crash. My error handler from hell gave me the address of the failing statement: bang in the middle of my overlay buffer. Yeah, well, thanks and everything, but which routine in which overlaid unit was crashing at that location? I mention in passing that the application has about 100 overlays, and more Turbo Vision spaghetti than Italy.

So what was I to do? I needed more information on the overlay system. I picked up the Turbo Pascal manual, dusted off Turbo Debugger, and descended into virtual 8086 mode.

Basics

Overlays are a method of fitting a very large program into a restricted area of memory. Part of the program is compiled into a separate overlay file, and a clever overlay manager pulls in code blocks from this file into a common buffer when they are needed. A code block which is no longer being used can be discarded in favour of another code block. The overlay system in Turbo Pascal V6.0 is very easy to implement (a couple of switch settings and some code preamble to set up the manager), and even has some rudimentary tuning parameters to help it run more smoothly.

I shall be describing the overlay system as implemented in Turbo Pascal V5.5 and V6.0 (they are the same); I no longer have V5.0 and so am unable to check whether the following is substantially true or not. I would recommend at this point that you read the Turbo Pascal manuals on the overlay system (for V5.5 see the *Reference Guide* and the *OOP Guide*, for V6.0 see the *Programmer's Guide*); I shall assume from now on that you have a good knowledge of the overlay system as described officially by Borland. I'm afraid I also assume some rudimentary assembly language knowledge as well.

If you're feeling adventurous, you could investigate how to move the overlay buffer

In at the shallow end

First point of attack is all those undocumented identifiers, described oh-so-tersely in the manuals. These are presented in Table 1, together with any extra information I've gleaned on the official ones. Before looking at it, I must introduce a definition. You all know what the segment part of an address refers to (the offset in paragraphs from the start of memory). Well, the overlay manager uses another type of segment value, one that is measured from the start of the program code itself. Every time one of these segment values is used, it has to be translated (relocated) to the absolute segment form. This is easy: just add the Program Segment Prefix segment (`PrefixSeg`) and the size of the PSP in paragraphs ($10). I shall call this unrelocated

```
type
  PUnitStubBlock = ^TUnitStubBlock;
  TUnitStubBlock = record
    usbInt3F     : word;
      { Always $3FCD, the INT 3Fh instruction }
    usbRetOfs    : word;
      { Offset of first return address }
    usbFileOfs   : longint;
      { Offset of unit in overlay file }
    usbCodeSize  : word;
      { Unit's code size in bytes }
    usbFixupSize : word;
      { Size of fix-up data block in bytes }
    usbEntries   : word;
      { Number of entries in the jump table }
    usbNextBlock : word;
      { Locale of next stub block }
    usbBufferSeg : word;
      { Segment of unit in overlay buffer }
    usbWasCalled : word;
      { 1 if unit was called on probation }
    usbNextLoad  : word;
      { Locale of next loaded stub block }
    usbFiller    : array [1..5] of word;  { Unused (?) }
  end;
```

Figure 1 - The unit stub block

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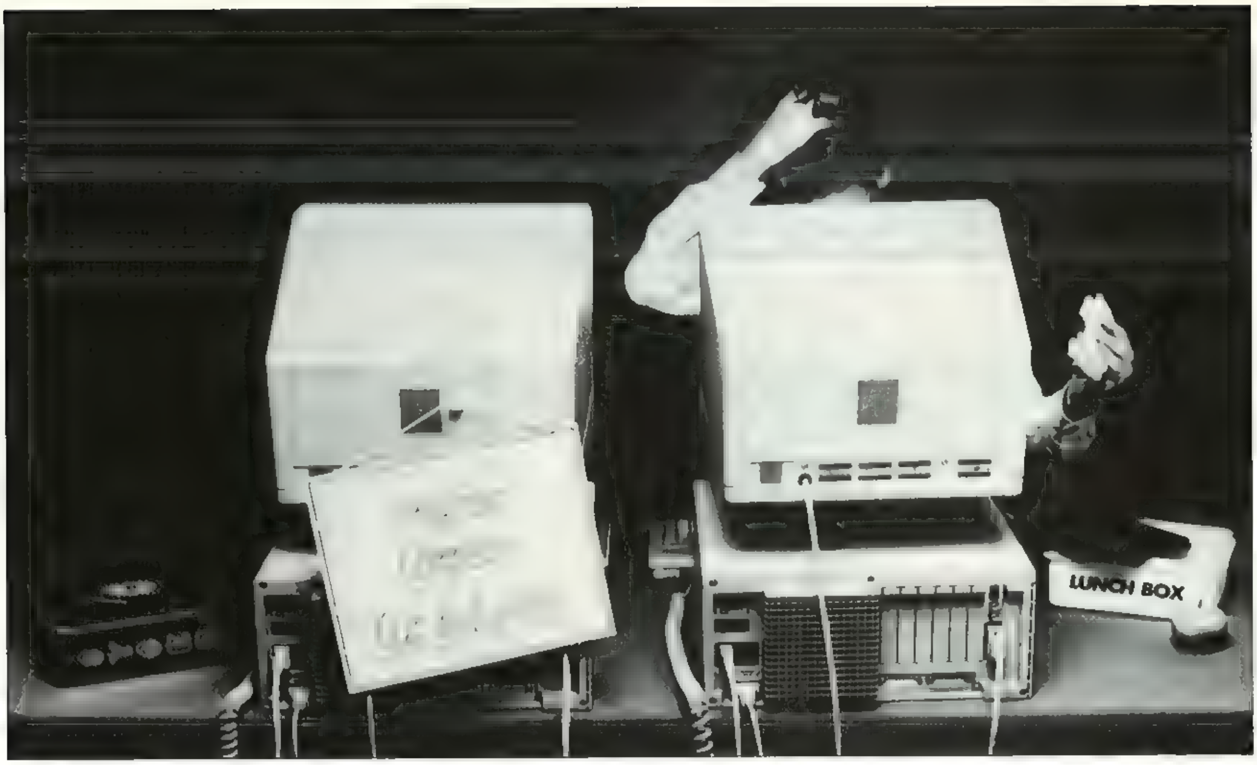
LUNCH BOX

segment a *locale*; this conjures up a mental image of the words local and address so it shouldn't be too difficult to remember (if it catches on, you read it here first!).

As you can see from Table 1, we have some intriguing variables (actually typed constants) to play with later on. First, however, a basic question. How **does** the overlay manager know when an overlaid routine gets called? Enter the unit stub block and the jump table.

When your program gets linked, each of your handcrafted overlaid units gets put into the .OVR file, and a 'stub' is left in the .EXE file itself, one for each unit. This 'stub' comprises the unit stub block (my term, I haven't a clue what it's called at Borland) and its jump table. The unit stub block is 32 bytes long and has the layout shown in Figure 1. Immediately following this stub block is a 'jump' table. Each element of this table is 5 bytes long, and there is one entry for each exported routine from your overlaid unit. A call to a routine in an overlaid unit will actually call the relevant jump table entry. The overlay manager 'notices' (exactly how is explained later!), and if the code for the routine is not yet in the overlay buffer, the unit is loaded, and the jump table adjusted to point to the code. Similarly, if the unit gets moved in the overlay buffer, the jump table gets adjusted again. When the unit gets overwritten ('removed' if you will), the jump table is adjusted once more.

`OvrReadBuf` (Procedure variable)

Allows you to intercept overlay load operations by writing your own read routine. Documented a bit in the manual. Could be used, for example, to write a routine to load overlays that have been compressed, or that reside in XMS. Although it is documented which overlay is required (parameter `OvrSeg` is just the segment of the unit stub block, described in the text), where it goes and whether any fix-up exercise has to be done is totally undocumented (the answers are at `ubsBufferSeg`, and yes!). `OvrInitEMS` replaces the standard loader with its own.

`OvrCodeList` (Word)

The manual calls this the 'Overlay code segment list'. This is a 'locale' (defined in the text), and it points to the first unit stub block. The unit stub blocks form a chain which you can 'walk' to get information about any overlay unit.

`OvrLoadList` (Word)

The 'Loaded overlays list'. Again a locale, but this points to the first overlay stub block whose code is currently loaded somewhere in the overlay buffer. These stub blocks form a chain which you can 'walk' to get information about any unit that is currently loaded. In other words, it provides the map of the overlay buffer. The unit code block pointed to by this variable is the 'oldest' unit in the overlay buffer and will be the first to be removed, ie it's the tail of the ring buffer.

`OvrDebugPtr` (Pointer)

The 'Overlay debugger hook'. Used by the overlay manager to tell Turbo Debugger that it has just completed a probation trap or unit load operation. This should be a far procedure with no parameters. ES is the unit stub block segment, BX the offset of the called routine in the unit code block.

`OvrHeapSize` (Word)

The 'Initial overlay buffer size'. True, but it's quoted in paragraphs not bytes (cf `OvrGetBuf`).

`OvrHeapPtr` (Word)

The 'Overlay buffer pointer'. This segment value actually points to the bottom of the free space in the overlay buffer. The next overlay unit will be loaded here. The head of the overlay buffer.

Table 1 - Undocumented Identifiers

Going deeper

Slightly more detail now. Each jump entry is initially set by the compiler to an INT 3Fh instruction (2 bytes) followed by the routine's offset in the unit (2 bytes) followed by a zero byte. Suppose an overlaid routine gets called and there is nothing in the overlay buffer. As mentioned before, the call goes to the start of the jump table entry for the routine. The INT 3Fh gets executed and lo! the overlay manager gets control (`OvrInit` installs it as the INT 3Fh interrupt handler). At this point the stack looks like Figure 2.

Excellent! The segment word of the return address is none other than the segment of the unit stub block, the offset word points directly to the routine's offset in the unit's code block. The overlay manager can now work out the location of the unit in the overlay file (field `usbFileLoc`). The unit's code is loaded (together with the fixup data block) into the overlay buffer at `OvrHeapPtr`, any fixups are done (and the fixup data block discarded), and the jump table entries are all altered to 5-byte far JMPs (we now know the segment address of the code in the buffer, and the offset was in the jump table to begin with). `OvrHeapPtr` is altered to point at the next segment in the overlay buffer. By manipulating the stack, the overlay manager ends by transferring control to the newly loaded routine. From now on, calls to this routine will meet with a far JMP straight to the code, and the overlay manager will neither know about nor interrupt them.

Easy-peasy, huh? However, it gets more complicated when units are about to get discarded from the buffer. Let us ignore probation for the moment and assume unit A has been in the overlay buffer for a while. Another unit needs to be loaded and the overlay manager notices that unit A will have to go (it's at the tail of the buffer). Now some of A's routines may be active, ie they have made calls to other routines and are waiting for these routines to return. The return addresses are on the stack. If we remove the unit, these return addresses will be pointing in the middle of some other code in the overlay buffer. The overlay manager needs to fix the stack so that it gets control when these returns are executed. To do this, it has to assume two things: (1) all RETs are far (ie all routines run up to now have been compiled with the far model: the return addresses will have segment and offset components), and (2) all routines push BP (the stack frame pointer for their caller) as their first action. Turbo Pascal does this automatically for you when you declare procedures and functions as far; beware, however, if you do some assembler programming.

The overlay manager can now 'walk' through the stack until it finds a return address segment for the unit about to be overwritten. It saves the corresponding return offset, and replaces the full return ad-

Top of stack segment
...
...
...
Original Caller's return segment
Original Caller's return offset
Flags
Return segment from the INT 3Fh
Return offset from the INT 3Fh

Figure 2 - The stack the overlay manager sees

```
procedure OvrTracker; far;
  { OvrTracker gets called whenever the overlay  }
  { manager is about to relinquish control.      }
  { Install with the statement:                  }
  {   OvrDebugPtr := @OvrTracker;                }

  const
    LoadCount : word = 0;  { Tracks OvrLoadCount }

  var
    StubBlock  : PUnitStubBlock;
    RoutineOfs : word;

  begin
    { When called, ES is the segment of the unit }
    { stub block, BX is the offset of the routine}
    { in the unit itself.                        }
    asm
      xor AX, AX
      mov StubBlock.Word[0], AX
      mov StubBlock.Word[2], ES
      mov RoutineOfs, BX
    end;

    { Increment the number of times StubBlock    }
    { has been trapped.                          }
    { The 5th filler word is used as a counter.  }
    inc(StubBlock^.usbFiller[5]);

    { If OvrLoadCount has changed, the unit used }
    { by StubBlock has just been loaded.         }
    { The 4th filler word is used as a load      }
    {   counter.                                 }
    if (OvrLoadCount <> LoadCount) then
      begin
        LoadCount := OvrLoadCount;
        inc(StubBlock^.usbFiller[4]);
      end;

    { At this point, you may call another        }
    { UNOVERLAID routine, and pass StubBlock and }
    { RoutineOfs as parameters if needed.        }

  end;
```

Figure 3 - The OvrTracker procedure

dress with the unit stub block segment, zero offset (ie the INT 3Fh instruction in the stub block: ah ha, light dawns!). The saved offset is placed in field `usbRetOfs`. The manager continues its walk, and all other return addresses for the same unit will have only their segment word changed, to point at the unit stub block (don't worry, they are never executed in this half-and-half state). When the program eventually executes a RET to a removed routine, the unit stub block will get called instead. The INT 3Fh is executed, and the overlay manager gets control. It notices that it was called due to a RET (the last word on the stack will be a 2 - think about it), loads the unit, and patiently refixes all the unit's return addresses on the stack (ie all return addresses that have a segment equal to the unit stub block). Finally, it pushes the return address that should have been used (the segment is the unit's new segment in the buffer, the offset was stored at `ubsRetOfs`) onto the stack, and issues a RETF.

By now you should recognise that the stack fixing stuff gets done every single time a unit gets loaded, or indeed every single time it gets shuffled around the buffer. If the unit is in the buffer, its return address segments in the stack point into the buffer, if not, they point to the unit stub block. In fact, every time the overlay manager gets called, it walks the stack and fixes the segments for any overlaid unit it finds. Better safe than sorry.

The probation scheme works in roughly the same way. When the overlay manager notices that a unit has entered the probation area, its jump table is altered to the INT 3Fh version. If the unit gets called on probation, the `usbWasCalled` flag gets set and the jump table altered to far JMPs once more. When the unit reaches the tail of the buffer, the overlay manager notices the flag has been set, resets it, moves the unit's code from the tail to the head of the buffer and gives the unit another ride around.

Time to Interfere

The procedure in Figure 3 (OvrTracker) is a debug routine whose address you can install into `OvrDebugPtr`. OvrTracker uses two unused fields at the end of each unit stub block to track probation and load calls. As mentioned in Table 1, the debug procedure must be far, with no parameters. On entry, ES is the segment of the unit stub block in question (BX is significant as well, it is the offset of the routine to be called). We don't know explicitly (as far as I know) whether the procedure was called due to a probation trap or a unit load, just that it will get called as the last thing the overlay manger does before returning to the main program. I've declared a single typed constant (mimicking `OvrLoadCount`) to track the load calls. Install `OvrTracker` immediately you've initialised the overlay manager, the manager's EMS driver (if used), and have finished altering the overlay buffer size.

The code is small and easily understandable. One warning, do *not* put this procedure in an overlaid unit: the program will nose-dive at Mach 2. At the end of the procedure is a comment showing where you could place a call to another procedure, for example to dump the overlay buffer map to disk or printer. Again, to be pedantic, do *not* put this called procedure in an overlaid unit, and do not allow it to use any overlaid routines in its turn. Remember when this procedure is called, the overlay manager is still active and it definitely is not re-entrant.

```
function RealAddr(Locale : word) : PUnitStubBlock; near;
  { RealAddr calculates the actual address of a  }
  { PUnitStubBlock from a locale value           |
  begin
    { A locale of zero = the end of the chain    }
    if (Locale = 0) then
         RealAddr := nil
    else RealAddr := Ptr(Locale + PrefixSeg + $10, 0);
  end;

procedure OvrWalker(FullList : boolean);
  { OvrWalker walks through the full unit stub   }
  { block list if FullList is true, otherwise it }
  { walks through the list of loaded stub blocks.}
  var
    StubBlock  : PUnitStubBlock;

  begin
    { Get the first stub block in the chain }
    if FullList then
         StubBlock := RealAddr(OvrCodeList)
    else StubBlock := RealAddr(OvrLoadList);

    { Walk through the chain ... }
    while (StubBlock <> nil) do
      with StubBlock^ do
        begin
          { Get next stub block in the chain }
          if FullList then
               StubBlock :  RealAddr(usbNextBlock)
          else StubBlock := RealAddr(usbNextLoad);
        end;
  end;
```

Figure 4 - The OvrWalker procedure

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CIRCLE NO. 488

```
UNIT OvrUsage;

{$O-} { No overlays allowed here }

INTERFACE

uses Overlay;

IMPLEMENTATION

type
  PUnitStubBlock = ^TUnitStubBlock;
  TUnitStubBlock = record
    usbInt3F      : word;
    usbRetOfs     : word;
    usbFileOfs    : longint;
    usbCodeSize   : word;
    usbFixupSize  : word;
    usbEntries    : word;
    usbNextBlock  : word;
    usbBufferSeg  : word;
    usbWasCalled  : word;
    usbNextLoad   : word;
    usbFiller     : array [1..3] of word;
    usbOurLoads   : word; { 4th filler - redefined }
    usbOurTraps   : word; { 5th filler - redefined }
  end;

{ The saved previous exit procedure }
var
  ExitSave : pointer;

{ Procedure OvrTracker is the essentially the }
{ same as that in Figure 2; we don't want the }
{ routine offset this time however.           }
procedure OvrTracker; far;
  const
    LoadCount : word = 0;
  var
    StubBlock  : PUnitStubBlock;
  begin
    asm
      xor AX, AX
      mov StubBlock.Word[0], AX
      mov StubBlock.Word[2], ES
    end;
    inc(StubBlock^.usbOurTraps);
    if (OvrLoadCount <> LoadCount) then
      begin
        LoadCount := OvrLoadCount;
        inc(StubBlock^.usbOurLoads);
      end;
  end;

{ RealAddr calculates the actual address of a }
{ PUnitStubBlock from a locale value          }
function RealAddr(Locale : word) : PUnitStubBlock; near;
  begin
    { A locale of zero signifies the end of a chain }
    if (Locale = 0) then
         RealAddr := nil
    else RealAddr := Ptr(Locale + PrefixSeg + $10, 0);
  end;

{ Procedure ReportUsage is designed as an exit }
{ procedure. It reads the MAP file to get the  }
{ unit names, and then dumps the unit usage    }
{ statistics to file OVERLAY.DMP.              }
{ WARNING - contains NO error checking.        }
procedure ReportUsage; far;
  const
    MaxUnits = 100; { The max no of units we cater for }
  type
    UnitName = record { To store data for each unit }
      Locale : word;
      Name   : string[8];
    end;
  var
    i, ec        : integer;
    StubBlock    : PUnitStubBlock;
    StubLocale   : word;
    F            : text;
    MapFileName  : string;
    Line         : string absolute MapFileName;
    NameArray    : array [1..MaxUnits] of UnitName;
    Finished     : boolean;
  begin
    ExitProc := ExitSave;

    { Assume we're running under MSDOS 3.0+, and }
    { the MAP file name is the same as the EXE   }
    { file name with a '.MAP' extension.         }
    MapFileName := ParamStr(0);
    MapFileName[0] := char(Pos('.', MapFileName) - 1);
    MapFileName := MapFileName + '.OVR';

    { Open the MAP file }
    Assign(F, MapFileName);
    Reset(F);

    { Miss the first three lines (the headings) }
    for i := 1 to 3 do readln(F, Line);

    { Read through the MAP file until we get to  }
    { the the line for the heap. For each line   }
    { read, get the start locale and unit name   }
    { and store in the local array NameArray.    }
    i := 0; Finished := false;
    repeat
      readln(F, Line);
      inc(i);
      with NameArray[i] do
        begin
          Line[1] := '$';
          Val(Copy(Line, 1, 5), Locale, ec);
          Name := Copy(Line, 23, 8);
          if (Name = 'HEAP    ') then Finished := true;
        end;
    until Finished;
    Close(F);

    { Open the statistics file OVERLAY.DMP, }
    { output the headings.                  }
    Assign(F, 'OVERLAY.DMP');
    Rewrite(F);
    writeln(F, 'Overlay usage for ', ParamStr(0));
    writeln(F);
    writeln(F, 'Name----  -Size  Traps  Loads');

    { Now walk the unit stub block chain }
    StubBlock := RealAddr(OvrCodeList);
    StubLocale := OvrCodeList;
    while (StubBlock <> nil) do
      with StubBlock^ do
        begin
          { Find the unit name }
          i := 0;
          while (NameArray[i].Locale <> StubLocale)
          do inc(i);

          { Write details to the Usage file }
          writeln(F, NameArray[i].Name,
                     usbCodeSize:7,
                     usbOurTraps:7,
                     usbOurLoads:7);

          { Get next stub block in the chain }
          StubBlock := RealAddr(usbNextBlock);
          StubLocale := usbNextBlock;
        end;
    Close(F);
  end;

var
  OvrFileName : string;

begin
  { Assume we're running under MSDOS 3.0+, and   }
  { the overlay file name is the same as the EXE }
  { file name with a '.OVR' extension.           }
  OvrFileName := ParamStr(0);
  OvrFileName[0] := char(Pos('.', OvrFileName) - 1);
  OvrFileName := OvrFileName + '.OVR';

  { Initialise the overlay manager, with a buffer}
  { twice the size of the original. Set the      }
  { probation area.                              }
  OvrInit(OvrFileName);
  OvrSetBuf(OvrGetBuf * 2);
  OvrSetRetry(OvrGetBuf div 3);

  { Install OvrTracker. }
  OvrDebugPtr := @OvrTracker;

  { Install the ReportUsage routine as an exit }
  { procedure.                                 }
  ExitSave := ExitProc;
  ExitProc := @ReportUsage;
end.
```

Figure 5 - An example Overlay Usage unit

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CIRCLE NO. 489

The procedure in Figure 4 (OvrWalker) enables you to walk the unit stub block chains: both the full chain and the loaded units chain (the overlay buffer map), its action dependent on a passed boolean parameter. The former mode could be used in an exit procedure to dump the usage of the overlaid units at the end of the program (especially if you've installed `OvrTracker` as well). The latter mode could be called by `OvrTracker` itself, to dump the overlay buffer map to disk every time the overlay manager gets control. As an alternative, you could install it in your own error handler from hell, to be called when a run-time error occurs in the overlay buffer.

The only problem with `OvrWalker` and the unit stub blocks is that you've no real idea which unit they're talking about. Enter the MAP file. If you compile your program with the TPC compiler and use switch /GS, you'll create a MAP file showing all the segments in your program: code, data, stack, and heap. Each line in this MAP file shows the start and end segment values (locales in my parlance), the size in bytes, the name and class of each segment. If you walk through the unit stub blocks with `OvrWalker`, their locales can be matched to the start locales in the MAP file. The best thing to do would be to simply dump the unit stub blocks to a file from within your program, and then write an analysis program to operate on this file. By reading and parsing the MAP file first, the analysis program could easily attach meaningful unit names to each of the stub blocks. In Figure 5, I show the code for a unit (with no error checking for brevity's sake) that initialises the overlay manager, installs `OvrTracker`, and, on program termination, uses the MAP file to produce a simple usage dump of the overlaid units.

Conclusion

As I have shown, the Turbo Pascal overlay manager is extremely sophisticated, both from an external viewpoint and also from watching its internal machinations.

From the undocumented features I have laid bare, you can now find out how best to use overlaid units, which ones to overlay, and conversely, which ones not to. You can find out by observing your own program whether the recommended probation size (one third of the overlay buffer) is the best for you. You can decide whether to split up large overlaid units or not.

If you're feeling adventurous, you could investigate how to move the overlay buffer, how to shrink it, and (harder) how to grow it dynamically, as your program relaxes and intensifies its demands on the heap. Perhaps, like me, you could write your own unit to load overlaid units from XMS rather than EMS, disable the 64 KB EMS page frame, and reuse the memory for something else (the overlay buffer?).

EXE

Julian Bucknall has been designing and programming for 12 years, and full-time in Turbo Pascal for the last three. His other favourite language used to be RPG III, so there's no hope. Off work, he can be found at the wheel of his red Volvo 1800S in and around London, a Saintly vision.
Turbo Pascal V6.0 Professional is a product from Borland International (0734 321150), and is available from all the dealers, eg Grey Matter (0364 53499) asks £137.

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CIRCLE NO. 491

Towards a fully object-oriented Clipper

Nantucket is evolving Clipper away from its dBASE compiler origins towards an OOP future, as Chris Sennitt explains.

Nantucket has been talking about an object-oriented Clipper since 1988. This article looks at how far down the road Nantucket are with this technology; which problems have been tackled by the current (5.01) release of Clipper, and those which remain to be addressed.

When considering Clipper's evolution, it's important to understand the enormity of the problem that Nantucket faces: how to convert the thousands of Clipper programmers to OOP without frightening them into the arms of, say, Fox or Borland. Many Clipper programmers come from a non-technical background, having started out using a 'faster dBASE'. The strategy Nantucket has adopted appears to be the evolutionary approach, with incremental upgrades gently easing the Clipper programmer into a new ways of solving complex business problems.[1]

This strategy has worked well with earlier upgrades. User Defined Functions, for example, were a simple extension to the old procedure mechanism: change the word procedure to function, add a return expression and you have a function not a procedure. Although OOP is slightly more complex, the current campaign to upgrade the current user base from Summer '87 version to the 'OOPier' 5.01 release appears to be working.

```
local aFreq[10], aHtz

// Copies the array pointer aFreq to aHtz

aHtz := aFreq

aFreq[1] := 1066

? aHtz[1]              // Outputs 1066
```

Figure 1 - Assigning Clipper array variables

Under the surface

What was in the current release of Clipper 5.01 reflecting the modernisation of the language? There was a pre-processor and a handful of operators borrowed from C, and a sophisticated Virtual Memory Management system which allowed programs to handle up to 16 MB of variable storage.

But most notably *missing* from this release was a full implementation of OOP. Instead, Nantucket supplied four fixed classes, a Table Browser (`TBrowse`), a Table Column (`TBColumn`), an Error class (`Error`) and a Get class (`Get`). There was no facility to define or create new classes. These four fixed classes have had a mixed reaction. For the novice they are confusing, for the adventurous Clipper programmer it's just enough to whet the appetite, and for the full professional it's not enough.

Nantucket has recently announced that the next release of Clipper 5 will have a full implementation of OOP, with an object-oriented SQL Interface to follow. Although Nantucket was 12 months late with Clipper 5, I think the steps taken towards OOP so far indicate that the full OOP version is not too far off.

What steps has Nantucket made towards OOP? For a start there's the business of multi-typed variables. Clipper is a dynamically-typed language; so you can write

```
mixup := 1
```

and subsequently code

```
mixup := "Surprise!"
```

and go on to assign a date to `mixup`, then a logical, then an array etc. While this feature is ripe for abuse by inexperienced programmers, it does have legitimate uses. Clipper Summer '87 was limited in this area; arrays could not be passed to and from functions, and array elements could not contain other arrays. Release 5.01 removed these limitations. Arrays are now no different to any other variable, and elements of arrays may now hold any data type, including objects and arrays. This has OOP implications because, from the point of view of the Clipper language, objects and arrays are very similar. An object's instance variable can hold any data type, including arrays and objects. So we can imagine an object containing an instance variable that contains an array of objects that each contain an instance variable that has an array... to any depth.

Then there's Clipper's system of garbage collection. The Virtual Memory Management system, combined with its dynamic typing, allows Clipper to recover unused memory automatically. In most typed, declarative languages the scope and lifetime of a variable (and its memory space) can be calculated at compile time and code is generated to reclaim this memory. In some languages, destruct messages may be sent that clear down other run-time resources such as file handles. With a non-declarative, dynamically typed language, scoping rules and the lifetime of some variables can only be deduced at run-time.

To understand the problem, look at the implementation of arrays. It's important to distinguish between the space allocated to a Clipper variable and the separate piece of memory allocated to its data. Internally the variable contains a reference to the array memory, in much the same way that a C `char *` points to the actual string. The pointer stuff is completely hidden from the Clipper programmer (thus removing the requirement for 90% of the debugging ses-

sions performed by his C-bound brother!), although it becomes obvious from the way arrays are used (See Figure 1). We now have two variables referring to the same array, the rule in Clipper is that an array does not get garbage-collected as long as something live points to it. Clipper's VM system is very sophisticated; it does not use reference counting to decide if something can be reached as this is too easily fooled (see Figure 2). Clipper incrementally scans memory variables tagging blocks of memory that can be reached. Memory that is not tagged is released for future use.

In C++ an object may be compared to a C structure plus methods associated with that structure. Internally, 5.01 objects are arrays with associated methods. So the VM usage for objects is identical to arrays: they live as long as they can be reached.

There's also the *send* operator. Implementation of the Clipper language is split into two parts, the compiler and the run-time system. The 5.01 Compiler now understands the send operator ':' (eg `object:message`). This generates very simplistic code that 'sends' the object to a run-time system function, along with the message and any parameters. The run-time system looks up the method associated with the message for that class and passes control to this method along with the parameters. So both the compiler and the run-time system have some understanding of OOP. All that is missing from the standard Clipper is the ability to define your own classes.

So the internals of 5.01 are already object-oriented; this is how the supplied four fixed classes can operate. Third party products, like my own company's *SuperClass*, use these internals to implement a full object-oriented extension to 5.01 and have been available since May 1991. SuperClass allows the application programmer to define new classes via some User Defined Commands. These commands load the internals of Clipper with the definition of the classes, number of instance variables and the associated messages and methods. The fixed classes supplied with 5.01 load the internals in the same way, so the add-ons are just exploiting the built-in support for objects.

A Good Question

'If all this is already in place, why hasn't Nantucket implemented full OOP?', you cry. I believe Nantucket could have implemented an OOP extension between the releases of 5.0 and 5.01 (a six month period). Here at ChyDale Software, it took us a matter of weeks to get SuperClass into alpha-testing, and that's without access to the run-time source code.

```
// The fooling of the reference counter

do while .t.           // loop forever
   foolit()
enddo

function foolit()
   local a[10], b[10]  // both arrays have a reference count of 1

   a[1] := b           // increase reference count of b by 1
   b[1] := a            / increase reference count of a by 1

return( nil )

// return will remove variable a and b thus reducing the
// reference count of the array referred to by a and b by 1
// Final count would be 1 so they stay in memory but cannot
// be reached.

// Clipper does not use this Primitive mechanism
```

Figure 2 - Problems with reference counters

I believe that Nantucket is delaying for two reasons: as a continuation of its gently, gently approach to introducing New Things; and to enable it to keep Clipper in step with its future technology (ie the Aspen 'Clipper-for-Windows' project). By moving forward at 'just the right speed', it hopes to take a significant number of Clipper programmers into OOP. By developing the next DOS version of Clipper, code-named '5.X', in tandem with Aspen, Nantucket hopes to create a class definition syntax which is sufficiently robust to be used in both systems. This will help in the transition from Clipper 5.X to Aspen.

Possible Features

Now we have looked at the steps taken towards a full OOP Clipper, it is reasonably simple to deduce many of its features. The syntax is unlikely to be far from that of SuperClass and the other add-ons available. There are only so many ways to describe the names of the instance variables and the names of the methods, and in the past, Nantucket has not been afraid to borrow ideas from other languages.

That said, I expect other features to be added. For example, many SuperClass users have asked for mechanisms to control the assigning and accessing of instance variables. Suppose we have an object `Obj` with a piece of instance data `Dat`. Then the action

```
Obj:dat := 4
```

would cause a special piece of code, defined by the application programmer, to be called. C++ programmers will recognise this as analogous to overloading the = operator. Access to variables could be similarly regulated (there is no direct analogy for this in C++).

Most of the current add-ons allow the programmer to create private, public and read-only instance variables. I feel that this is not the Nantucket way. Access and assign routines could easily replace the need for these mechanisms, or alternatively the SuperClass mechanisms could easily be simulated with access and assign mechanisms.

Let's look at the possible syntax for defining an object. In this late-binding, dynamically-typed language, not much is required to define an object: a list of its instance variables and the code for the methods. Figure 3 shows a typical definition for a SuperClass object. Some lines may not be required by a fully OOPed Clipper that understands class definitions completely. These lines are indicated by comments. Figure 4 shows the syntax for single inheritance and the overriding of an inherited method (`init`). Although SuperClass supports multiple inheritance, Nantucket has made it clear that this feature will not be in the next release of Clipper.

Many of the internal features of 5.01 suggest that a lot of the implementation ideas have been derived directly from the Smalltalk language, most notably code blocks, arrays and objects. However, I doubt that Clipper will support for class objects. These are used in Smalltalk (and other late binding languages) to hold information about the class, with each class defined by exactly one class object. In Clipper, it's possible to hold equivalent information about classes by using class variables, which can easily be implemented using static variables in the class definition file.

Destruct

One of the problems that remains for Nantucket to solve is that of the destructor mechanism found in C++. Because C++ is declarative and uses early binding, it's possible to predict when an object 'goes out of scope', and it can then be arranged for a destruct mechanism to be called. In Clipper, the problem is much harder. An object 'dies' only when it can no longer be reached

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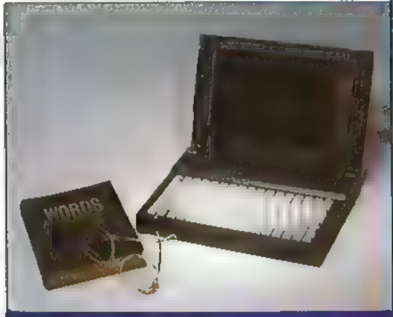

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by the VM system. We then hit a *Catch 22* problem: how do you send a destructor message to something you can't reach? If you can send it a message it must be reachable, and if it's reachable then you should not send it the destructor message. What is wanted is the ability to call the destructor as soon as the object is no longer reachable, and in reverse order of creation. It is not obvious how this can be achieved.

Preparing for the Future

If all this OOP is being introduced with half an eye on Aspen, what is Aspen all about? Mainly speed and Microsoft Windows. Aspen will include some very sophisticated run-time/compile technology that should enable a ten-fold increase in performance over Clipper 5.X. It will probably include optional type declarations that will give 'hints' to the compiler and run-time system for method look-up and instance variable access/assign. This should then give the best of both worlds, a late binding language that can be optionally early bound.

Many Clipper programmers are trying to write systems today that will easily transfer to both Clipper 5.X and Aspen. It is certainly Nantucket's goal to convert as many of

```
#include "SuperCls.ch"        // remove this line
#include "Inkey.ch"

local nKey, oImage


oImage := saveScreen():Init(  4, 4, 22, 47 )
do while (nKey:= inkey()) !=  K ESC     // The escape key 27
   do case
   case nKey == K_DOWN         // Down Arrow
      oImage:down()            // Move the image down one line
   case nKey == K_UP           // Up Arrow
      oImage:up()              // Move the image up one line
   endcase
enddo

Return

Class saveScreen

   var  top, right, bottom, left, image

// Remove from here


   Message init( t, r, b, l)
   Message up()
   Message down()
   Message display()

end class

// to here

Method init(t, l, b, r)
   self:Image := savescreen( t, l, b, r)
return( self )

method up()
   self:top --
   self:bottom --
return( self )

method down()
   self:t ++
   self:b ++
return( self )

method display()
   restscreen( ::top, ::left, ::bottom, ::right, ::image )
return( self )


// Note :: is a short hand notation for self:
// implemented with a #define :: self:
```

Figure 3 - Defining a Clipper object

these programmers as possible. So what do you have to do today to achieve this?

You should certainly avoid older style Summer '87 functions and commands. These are clearly marked in the manual and in the on-line guides. Declare all variables before they are used (LOCAL or STATIC) - this is a declaration of the variable's name, **not** its type. Avoid PRIVATE and PUBLIC variables, the scoping and lifetime rules make them very difficult to compile and optimise. Start to convert the systems over to OOP as soon as possible. Always compile with a /W warning flag, as this will notify you of any variables that are used without being declared.

End thoughts

So what have Nantucket got that's new to the industry? Very little, actually. Most of the features have been derived from other languages (code blocks, pre-processor, new operators, late binding, dynamic typing, non-declarative, virtual memory management). What is new is that all this is built around the Clipper language, something that's easily picked up by millions of existing dBASE programmers.

Is Nantucket's incremental upgrade strategy working? Most of the Clipper users I meet fall into one of two camps. One camp is using 5.01 for the automatic VMM system alone - ignoring all the additional features of the language I have been discussing. The other group is moving heavily into the new features; pushing the pre-processor to the limits, using 2 MB to 4 MB of VM space for variables, using object-oriented add-ons, abusing code blocks and making full use of the new array features. Admittedly the number in camp two is relatively small, but it is growing in both size and momentum. So the softly, softly approach does seem to be working.

EXE

```
#include "SuperCls.ch"                      // remove this line

Class CargoScreen inherit from saveScreen   // remove the "From"
   var Cargo

// Remove from here

   Message Init( t, r, b, l, data )

end class

// top here

Method init( t, l, b, r, data )

   :Super():init(t, l, b, r)        // Call the superclass init()

// super:init( t, l, b, r)  is a possible future syntax for 5.X

   Self:Cargo := data
return( self )
```

Figure 4 - Single inheritance in Clipper

Chris Sennitt is a Director of ChyDale Software, suppliers of SuperClass and other Clipper add-ons. Contact ChyDale on 0977 683 296.

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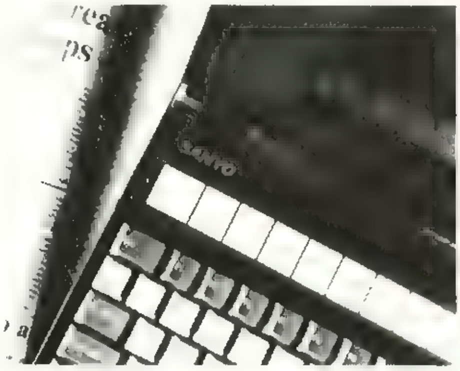

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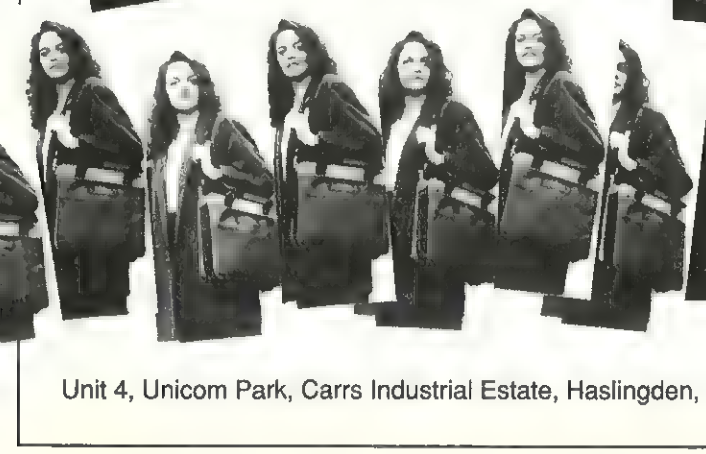

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Configuring programs

Configuration files can make programs more flexible and easier to maintain. Peter Collinson has a neat way of reading them.

There's always a temptation to burn too much knowledge into programs. By this I mean that many programs on UNIX have some information about their environment planted immovably into the binary. For example, programs that do clever things with terminals will need to access the `terminfo` or `termcap` databases; programs that validate users will know about the location of the password file; the wrapper for the C compiler `cc` will know where the binaries of its various passes can found on the system. The list goes on.

It has always been the practice to plant some sensible defaults into the binary and then supply the ability to change them by using program arguments. This is OK for programs that are run seldom, or for the occasion where the change in the defaults is temporary. It's painful to be forced to supply parameters every time a program is called. It's easy to do using aliases in the shell or front-end scripts, but it should be possible to provide better mechanisms.

Using the environment

One way of providing a program with information is to use the environment. This is a set of strings that are passed into processes on the `exec` system call. By convention the strings have the form:

```
keyword=value
```

like

```
SHELL=/bin/sh
```

Users generally set their environment from their shell.

It's easy to access the environment from a program, a standard routine is used:

```
shell = getenv("SHELL");
```

will return the right-hand side string if it exists, otherwise it will return `NULL`.

Setting the environment from programs used to be tricky, but many systems are adopting the `putenv` routine making setting things up somewhat easier. To change the `SHELL` variable, you would say:

```
rv = putenv("SHELL=/bin/csh");
```

The return value is a success/failure indicator.

The new environment variable is passed into any processes that are created by the program that called `putenv`. It's a common mistake to think that the strings are stored somewhere central. They are passed from parent to child. Consequently, the parent can affect the setting of a child's environment but the converse is never true.

However, we do sometimes want to allow a child of a shell to set a variable and a commonly asked question is how this may be done. It needs a slightly cunning trick. The programmer arranges to output a string looking like a shell command:

```
VAR=value; export VAR
```

for Bourne shell and

```
setenv VAR value
```

for `csh`. These strings are printed on standard output. Let's assume that the program that generates this is called `prog`. We want to execute these setup commands in the *current* shell to load the variable. This makes any new command started from the shell contain `VAR` in its environment.

Both flavours of shell contain a command `eval`. The command executes its arguments in the current shell. For Bourne shell, we can say:

```
$ eval "NEWVAL=newvalue"
```

this executes the command

```
NEWVAL=newvalue
```

in the current shell. Of course, this is more useful when the argument is a shell variable.

For our purposes, we must translate the standard output from `prog` into parameters for `eval`. This is easy, we use the back-quote operator. Putting this all together:

```
$ eval ‘prog’
```

This runs `prog` and picks up its standard output making arguments for `eval`. The `eval` command executes the arguments, which will set the environment in the current shell. We are in business.

Using the environment to provide program configuration information is fine. I am happy for it to contain things that are used regularly, like my search path or the `termcap` information supporting my editor and other visual programs. As I write, my current environment is 1471 bytes and contains 29 variables. Every new process that I start has to build a data structure containing the characters and establish a vector of pointers.

Being of the old school, I resent the CPU wastage. My ears are deaf to the arguments that say CPUs are faster and we have cycles to burn. Too many people say this, and the cycles are being nibbled in all directions. I want to minimise my environment. If your program isn't essential to my work, I don't want its variables cluttering up my world. They take up precious name space and slow me down.

Lists

The data that you want to get into the application may be unsuitable for loading as either arguments or environment variables. In this situation, the approach usually used on UNIX is to read data from a configuration file. The file will most often contain text and is maintained using the normal set of UNIX tools, created with an editor, searched with `grep`, sorted with `sort` and so on.

The simplest type of configuration information is a list of some kind. For instance, you want to send mail to a number of different

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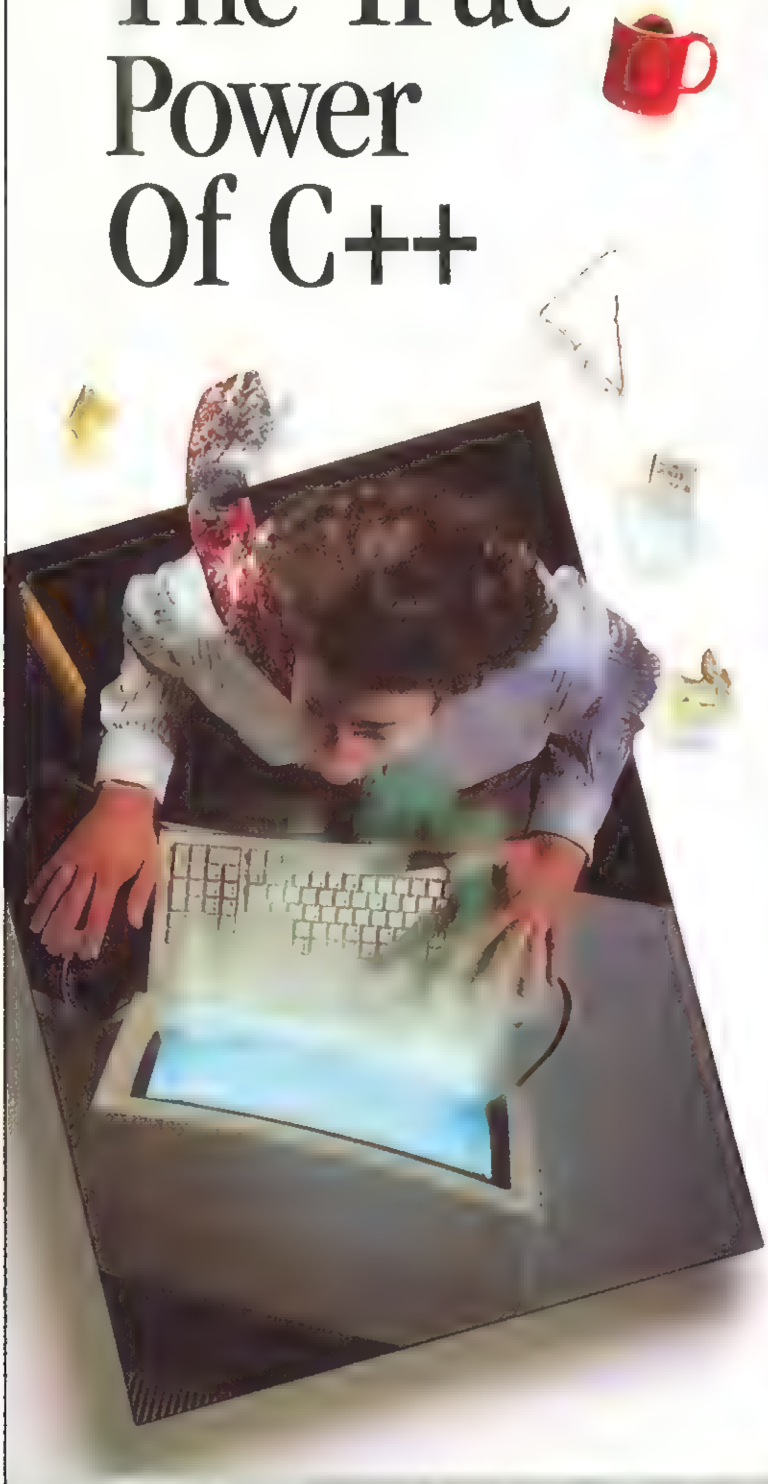

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people when your program has completed. Conventionally, a list like this is entered with one entry per text line. The program will open the file and input the data a line at a time for storage in a structure, or directly executing a mail command.

The code should worry about ignoring white space at the start of the line and also trailing white space. Some editors will add extraneous spaces at the end of lines, and the person doing the editing will not be aware that it is there. People expect to be able to insert dead space so that their control files look nicer.

Also, it's a good idea to provide a comment mechanism in the data file. I generally use hash ('#') at the start of the line to mean that all the text up to and including the next newline should be ignored. When you are writing the routines to process this type of data file, you will often read data a line at time using `fgets()`. As a result, comments are free - you just look at the first character and loop to get the next line. Incidentally, you can easily ignore blank lines by using the same mechanism.

The ability to have empty lines and comments in a control file adds a lot to its maintainability. Comments will allow the user to describe the values in the file. Also, they can contain version information making the file manageable by a source code control system like SCCS or RCS. A valuable feature is the ability to insert a '#' at the start of line to temporarily remove values without losing the data. Comments are just a good thing.

Simple configuration files

It's often the case that configuration information is relational. Rather than just having a simple list, we will want to have a number of keywords, each taking some value. It's possible that we want to associate more than one value with each keyword.

For example, there is a file used for storing credit in the UKnet accounting suite that I was involved with recently. If a site incurs a bill of less than £10, then an invoice of that sum is sent and the resulting credit stored. Next quarter, the credit is applied to the next bill.

The file that drives this contains lines of data, with one line for each creditor site. The line holds the name of the site, the date that the last charge was made and the amount of money that the site is owed. I use colons to separate the different fields in the data file, but any separator will do.

The credit file is generated automatically as a side effect of running the bill generation program, but it is still text. It can be examined using an editor. It can be updated easily too. If the site is invoiced outside the normal system, a human may want to come along and edit the file to reflect this.

It may seem that reading and processing one of these files is difficult. It isn't. Let's assume that we are writing an interface to the mail system. It's nice to have a private file of aliases so the user can say:

```
mail peter
```

and have `peter` expanded to the real address of the person. We will have a configuration file containing several lines like:

```
peter:pc@hillside.co.uk
```

Each entry in the alias file contains two colon separated fields. The first field is the name that you want to find and the second is the string that is returned for that key.

When implementing this, the initial thought is to use `fgets` to read each line and then examine the first part of the line with `strcmp` to find a matching key. This approach works but is slow, involving enormous amounts of copying. You can use a finite state machine to good effect here. The routine is to be found in Figure 1.

The idea is to loop while reading characters. Different tests will be done on each character that is read depending on the value of the variable `state`. We know where we are in the file, and what we expect to see next. We use our knowledge

```
/* Using a finite state machine */
/* to parse the alias file      */

#include <stdio.h>

char *
readalias(FILE *fi, char *key)
{
  enum {
    NAME, ADDR, SKIPEOL
  } state;

  static char line[BUFSIZ];
  char *pt;
  char c;

  state = NAME;
  pt = line;
  while ((c = getc(fi)) != EOF) {

    switch (state) {

    case NAME:
      if (c == '#')
        state = SKIPEOL;
      else
      if (c == ':') {
        *pt = '\0';
        if (strcmp(line, key) == 0) {
          pt = line;
          state = ADDR;
        }
        else
          state = SKIPEOL;
      }
      else
        *pt++ = c;
      break;

    case ADDR:
      /* success ? */
      if (c == '\n') {
        *pt = '\0';
        return line;
      }
      else
        *pt++ = c;
      break;

    case SKIPEOL:
      if (c == '\n') {
        pt = line;
        state = NAME;
      }
      break;
    }
  }
  return NULL;
}
```

Figure 1 - Code for finite state machine

of the syntax of the file to minimise the processing that is done.

The first state, NAME, is used when we are processing the left-hand side of each line. This is the initial state too. The idea here is to store the incoming characters until we find the colon that marks the end of the first field. When we get a colon, we can compare the data we have captured with the key. If the key matches, then we will need to store the right-hand side because that is the data that we need. We enter the ADDR state to do this. If the key does not match, then we can ignore the remainder of the line entering SKIPEOL state. If we find a hash character, then the line is a comment and should also be ignored.

The second state, ADDR, is only entered when we have matched the left-hand side. We store the characters that we need until a newline is found. Then we exit bearing a pointer to the line.

The final state, SKIPEOL simply discards the character until a newline is found, when it resets the state machine back to the beginning.

The code is actually very rudimentary and if you are planning to use it in anger, you need to worry about syntactically incorrect input. Getting a newline when in the NAME state is currently bad news. The state machine is possibly a little simple and it might be a good idea to deal with leading and trailing white space. You tend to do this by adding more states.

You can also improve on the raw use of strcmp. When dealing with strings I nearly always compare initial characters before executing the costly string comparison. It depends on the data involved, but it can save an enormous amount of processing.

However, apart from this, if you look again at the code you should see that it is very fast. The code path for processing each character is minimal, perhaps three or four tests and a store. Remember also that getc is an inline macro and most of the time is simply picking up a character from a buffer.

Sometimes finite state machines like this can get too complicated, such that it is difficult to see what is happening. I like them for simple applications like this one. They mean that the code works quickly and it is easy to see what will happen in any particular circumstance.

Configuring program suites

When you build a number of programs that work together it's often the case that they all need access to the same files containing various types of information. Rather than burning all the file names into each binary you might think about controlling the programs by the use of a single configuration file.

There are many benefits. All the programs only need to know about the location of a single file and derive all other information from that. It makes it easy to establish parallel environments for testing, and means that you only edit one file if you move the location of a file referenced by the suite.

The configuration file also becomes a handy place to store values that might otherwise be constants in the programs. If the working life of a suite is five or so years, then it's often the case that constants will change. For example, the 'constant' VAT rate recently changed from an integral 15% to a floating point 17.5%.

I generally create configuration files using the familiar

```
keyword: value
```

syntax, and will allow hash comments and blank lines. Different programs in the suite will need different information from the configuration file. The idea is that each program will search for a keyword, or a number of keywords, and ignore anything that isn't relevant to it. The value can be a number or a string - it's just some characters that the program must read and interpret.

The value is deemed to end when the newline is reached. The next line will contain another keyword and value pair. This is often restrictive since long character lines are a pain to maintain. Most of the databases that I construct allow you to continue the data on the next line:

```
# long line
Long: This is a
 long
 long
 line
```

Continuation is signalled by starting the line with white space - either a space or tab character. The reading routine will convert any newline characters into spaces and will consume any white space at the start of continuation lines. As a result the program will see the long line as:

```
Long: This is a long long line
```

There is one further trick that is worth describing. Often a program will deal similarly with several different objects. If your program deals with different types of fruit, then you might have a line saying:

```
Fruit: apple orange
```

Each of these entities might have a characteristic that the program needs to analyse. If we wanted to talk about the colour of the fruit, I would add lines like:

```
apple-colour: red
orange-colour: orange
```

The program dealing with this doesn't know about `apple` or `orange`. It only knows that it is making an internal structure and should read a list of possible fruits from the `Fruit` line. Each of the space separated entities will add a new category of fruit to be dealt with. Additional information about that category can be supplied by looking for keywords starting with the category name. We can generate a new keyword using a `sprintf` format of say:

```
"%s-colour"
```

Additional lookups are now made to get the values of `apple-colour` and `orange-colour`. This scheme is very extensible. Adding a new category, say `lemon`, will not involve any program recoding. You simply change the `Fruit` line and add new keywords:

```
Fruit: apple orange lemon

apple-colour: red
orange-colour: orange
lemon-colour: yellow
```

If you create a new program that needs to know something different about the fruit, then it's easy to add a range of keywords derived from the `Fruit` line.

Of course, in real life, programs rarely deal with fruit, but I hope that you get the idea.

EXE

Peter Collinson is a freelance consultant specialising in UNIX. He can be reached electronically as `pc@hillside.co.uk` *(although your mailer might be happier to put the address the other way round) or by phone on 0227 761824.*

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Books

Just to show we're not completely xenophobic C freaks - here's a PROLOG book.

Well, I do declare!

PROLOG - From Formal Specification to Prototype. After reading the title, you might be forgiven for expecting this to be an advanced PROLOG text, but it isn't. As the blurb on the back cover explains, the purpose of the book is to introduce the procedural programmer to the ideas of declarative programming. That's rather a mouthful, but it means that if you know a language such as C or Pascal, and you want to learn more about PROLOG, then this book should be for you.

As a book for PROLOG beginners, there are some rather useful features included in the text. There is a liberal sprinkling of exercises, along with solutions in an appendix. Throughout there are worked examples and 'Practical Activities'. These are mostly practical PROLOG sessions of the 'type this' variety, along with a commentary to explain the results. What if you don't have a PROLOG system? Well, for a few pounds, the authors will send you a PC disk. On it will be a 'no-frills' PROLOG interpreter for MS-DOS, as well as many examples of PROLOG code from the text. As a bonus, the ubiquitous EMACS editor has been included. Although the interpreter was a little fragile when running on my system, it does give you the opportunity to see the book's examples running, and at very little cost. This forms a valuable adjunct to the book.

The book's introduction to PROLOG is unusual, and perhaps startling. All programmers should be familiar with formal specification of an operation. Such a specification will usually include a list of parameters, a method, and a description of pre-conditions and post-conditions. Fewer programmers will be familiar with the notion of specifying the complete operation by these conditions alone. In the book, we learn that if these conditions are specified using PROLOG, then you don't need to worry about the functional details of the operation; PROLOG will do the rest. In other words, if you exactly specify the pre- and post-conditions of an operation, PROLOG will find values to satisfy those conditions. There is no need for the programmer to tell PROLOG *how* to find the values. As the title of the book implies, PROLOG provides the missing link between the formal specification of an operation and a working prototype.

With this blockbuster out of the way, much of the remainder of the book provides what you would expect from any PROLOG text. The bonus is that there is a strong 'hands-on' emphasis. Many (but not all) of PROLOG's primitives are introduced and explained as more complex examples are worked through. However, we are saved from the usual descriptions of expert systems and inference engines. Similarly, there are no travel planners, or draughts playing strategies, although there is a hint of natural language parsing. Sadly, just when you thought it was safe, the very last chapter is devoted to the 'Towers of Hanoi' problem. Yes, I know it is an excellent example of a problem with a succinct recursive solution, but if it is the *only* example, then recursion can't be all that useful, can it...?

How does the book deal with some of the more difficult aspects of PROLOG - backtracking, the cut, and procedural versus declarative meaning, for example? An explanation of backtracking inevitably means resorting to a diagrammatic representation of the CALL-FAIL-REDO-EXIT cycle, and the search tree. A few years ago, the Open University developed an excellent notation for both called the AORTA diagram. All three authors work for the OU, and yet they have not used AORTA diagrams, but less inspired 'engineering' boxes of their own. These work for the examples they have chosen, but for more deeply nested problems, I think there would be trouble. The cut is also explained using diagrams of their own design. Although the basic message 'green cut good, red cut bad' does come across, I would have liked more examples. Procedural versus declarative programming is dealt with by comparing Pascal and PROLOG implementations of the same problems. This links nicely with the notion of using PROLOG for formal specifications described earlier.

It is almost inevitable these days for such a book to include a chapter entitled 'Object Oriented PROLOG'. Accompanying this on the disk is OBLOG. What a tantalising but frustrating glimpse this is. I was certainly left wanting more.

In summary, if you want to learn PROLOG, this isn't a bad place to start. You'll frequently be left wanting to go further, and to do that, you'll need one of the reference texts. If you're an experienced PROLOG programmer, there's little here of interest.

Review by Dr Gareth Blower

Title: PROLOG - From Formal Specification to Prototype
Authors: Peter Leadbetter, Peter Thomas & Ray Weedon
Publisher: Blackwell Scientific Publications
Price: £17.50
Pages: 384
ISBN: 0-632-03161-1

Books Received This Month

Designing Your System with SmartWare II by M Gandoff & M Hicks	Butterworth	£19.95	ISBN: 0-750-6-0425-5	pp330
The Design of OS/2 by HM Deitel & MS Kogan	Addison Wesley	£32.25	ISBN: 0-201-54889-5	pp389
The Standard C Library by PJ Plauger	Prentice Hall	£29.95	ISBN: 0-13-131509-9	pp498
DECnet Phase V - An OSI Implementation by J Martin & J Leben	Prentice Hall	£30.95	ISBN: 0-13-203118-3	pp572
Programs and Data Structures in C (2nd Ed) by L Ammeraal	Wiley	£14.95	ISBN: 0-471-93123-3	pp272

Let Me Explain

In the first of a new regular slot, Francis Glassborow tells us all about the C Users Group.

Let me start by introducing myself. I am the Editor of CVu which is the journal of the C Users Group (UK) as well as being the Chairperson of that organisation. Unlike many editors of Special Interest Group publications I receive more material than the group can afford to publish.

I do not intend to fill the space that the Editor has provided with never-ending reasons why you, the reader, should join CUG(UK). Nor do I intend to waste your time and my space by listing events from our calendar unless they are of more general interest. This time I will tell you a little about us and our aims. In future I will tackle items that should interest programmers using C and its successors. I hope that some of what I write will be of a more general interest.

Let me tackle our title. The 'C' includes C++, Objective C, Concurrent C and other current and future developments in this area of programming. We do not believe that C is in some way special, just that it is an excellent language for many purposes.

The 'Users' includes the entire scale from enthusiastic amateur just starting to the long-term experienced professional programmer. It also includes those that provide the tools that we use, those that offer training and those that develop and monitor standards.'Group' is one of those all embracing terms that avoids some of the overtones associated with 'Club', 'Association' etc. Some aspects of the group do resemble those of a club. Members want to share their interest and insights, they enjoy the sense of belonging and indulge themselves with disagreements. On the other hand members are supportive of one another, they are willing to share experiences and insights and to provide help and advice when they can.

All of us need support occasionally. It is rarely as severe as the young programmer who rang me last year in despair because he could not see how to meet his employer's demands within the time-scale set. A quick hunt round and I was able to point him towards a UNIX tool that achieved the desired result in half the time allowed. The sense of someone else caring and supporting him in his moment of need was much more valuable.

The '(UK)' is simply to distinguish us from an American organisation that uses the same initials.

CUG(UK) has existed in its present guise since 1987. Its primary aim is to support members in developing their programming skills along sound but not dogmatic lines.

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For information about CUG(UK) write to 64 Southfield Road, Oxford, OX4 1PA or ring 0865 246490. Individual membership is £12 and £50 for company membership.

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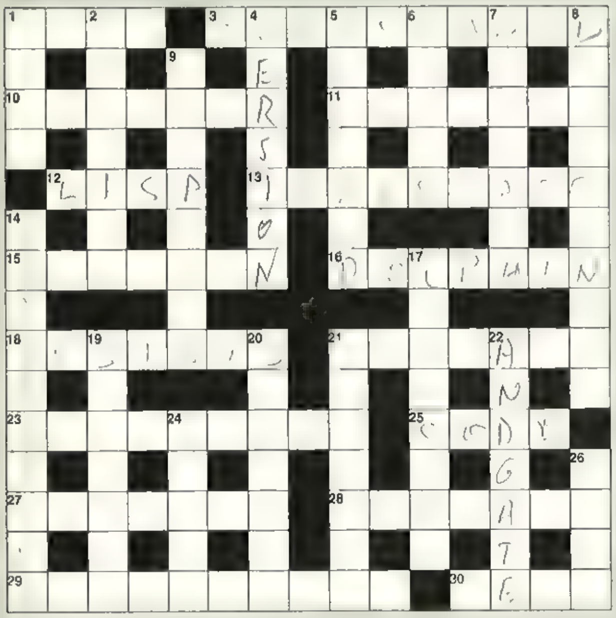

ACROSS

1 Nearly all applied solid-state physics (4)

3 Suffering at work from too large a current (10)

10 Container in backward phone measures may digitise (7)

11 Source of electrons in gun (7)

12 Thpeak thtrangely in some language (4)

13 Erase an eprom (9)

15 Crappy age where is many a game (7)

16 Aquatic mammal worker may block the leak (7)

18 How the conductor opposes the current (7)

21 He charged French dish (7)

23 In banking or police computer maybe a line of ...(9)

25 ... cryptic program? (4)

27 Opening character in one confused ending (7)

28 What n and s do (7)

29 Milliards of Tebbit's vehicles? (10)

30 International at the end of a coding exercise (4)

DOWN

1 Hide behind a set of bits (4)

2 Where to work on a network (7)

4 Type of system we need the latest of (7)

5 Writes the parts of a file (7)

6 Chosen from a drop tediously poured (5)

7 Jovian moon in a play in a 3D set (7)

8 Insulator with such a constant (10)

9 Voracious creatures in popular game (8)

14 Absolute or indexed, say (10)

17 Assign greetings to Catherine, I hear (8)

19 Format where satellites go? (7)

20 Varnish part of OS with alternating current (7)

21 Become delayed and let free in logic unit (3,4)

22 Needs two positive inputs for success (3,4)

24 The first modern computer (1942) (5)

26 Make no change about 30 (4)

'.EXEWORD' compiled by Eric Deeson

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E	■	L	■	D	■	L	■	P	■	S	■	P	■	E
R	E	A	D	Y	■	A	C	O	U	S	T	I	C	S
R	■	V	■	L	■	P	■	U	■	E	■	U	■	S
I	D	E	A	L	I	S	T	S	■	T	E	M	P	I
T	■	■	■	I	■	E	■	E	■	■	■	I	■	O
E	N	L	I	S	T	S	■	S	T	E	P	S	O	N
■	■	I	■	T	■	■	■	■	■	X	■	M	■	■
D	E	B	A	S	E	D	■	F	O	C	U	S	E	D
Y	■	R	■	■	■	E	■	O	■	H	■	■	■	E
N	E	A	T	S	■	N	O	R	M	A	L	I	S	E
A	■	R	■	E	■	T	■	E	■	N	■	A	■	J
M	A	I	N	T	A	I	N	S	■	G	A	M	M	A
I	■	A	■	A	■	S	■	T	■	E	■	B	■	Y
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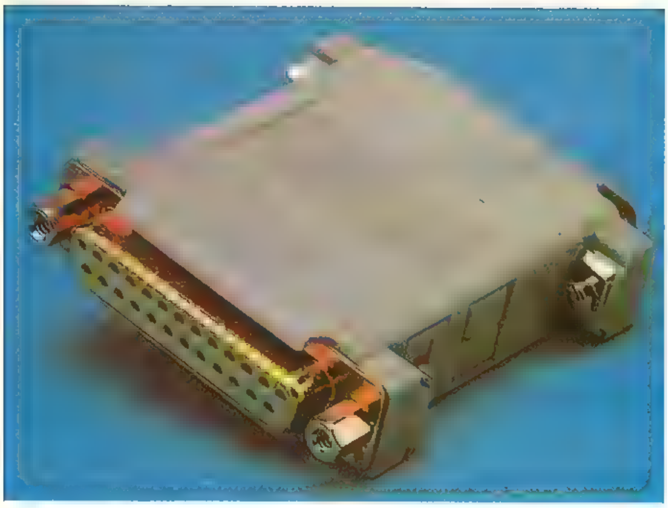

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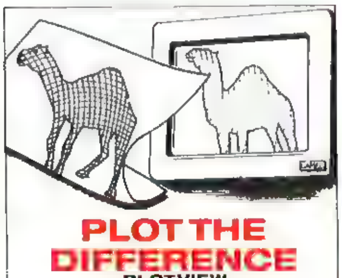

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For further details of these and other permanent vacancies, please contact S. Atkinson, quoting the relevant reference, on 071-734 4010 (office hours) or 071-431 2316 (evenings/weekends). Alternatively, write to McGregor Boyall, Sutherland House, 5/6 Argyll Street, London W1V 1AD, or fax your CV on 071-734 1297.

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STOB - Not fairies' footfalls

'Backing up? Why, backing up is for punters!' (Traditional).

Finish typing in ammended comment and hit Alt-V for **V**erity's Compile, Link, Save to disk and Run (it only took me about eight hours in macro programming to set this up, which quite justifies the two minutes it must save me each week). The server is right behind me, so I can hear the familiar rhythm of the 300 MB hard disk as the compiler shifts up through the gears, you know, I bet I could identify most of the software on our network blindfolded, I'm so familiar with the different sounds...

Hold up. Put smallthought on Pause a sec. It's *not* making the usual noise. Instead of fairies' muffled footfalls on drum, we have distant scream like inexpertly wielded bluntish drill bit skidding on car wing. Listen. There it is again.

Now, Verity, don't panic. Ignore cold feeling on nape of neck, suppress urge to hiss 'If you have lost this file I will *bite* you' into server's A: drive. Be calm. Be rational. Ctrl-C. There; that's broken out of the macro. Attagirl. **F**ile. Save **A**s. `C:\PLEASE.CPP`. And, with careful finger, press `ENTER` key, so that, in a second, in a second, 'QEMM has detected an attempt to execute an illegal instruction in the program you were running. Press E to end the program, or R to reboot the computer.' Or how about 'B' to tell QEMM to **B**og off and mind its own **b**loody **b**usiness.

Well, that's three hours work down the drain, ha-ha (no, that was a light laugh, no, not at *all* like that woman in *Casualty* whose head exploded), so I suppose we may as well find out what's up with server. DIR C:\, two trillion things flick by at the speed they do on a 486, fine. DIR D:\, same thing. DIR E:\, someone switches on the Black and Decker again, we have a General Failure Reading Drive E:\, guess which drive someone has entrusted with all her recent work, General Failure Verity's Temper; Abort, Retry, Ignore, Scream.

Look at backup log, to discover who made most recent weekly copy of server. Dave. Uh-huh. You remember Dave - the man with two talents: he can solder an IC chip holder onto a bit of vero while squinting through the smoke of a Silk Cut Menthol, and he cheats on his wife every Thursday night - she believes it has taken a year to repaint the TA hut. Dave's just the chap to be entrusted with my life's, ok week's work.

Oh, Hi Dave, you couldn't just lend me the tape of the backup that you made last Friday. What's that? You didn't do a *full* backup? So what sort of backup did you make, you old cockchafer? You made a partial backup of C: and D: did you, you old cockchafer. Well you know what, you old cockchafer, you're not fit to back up a 1969 Mini on a disused airstrip, never mind a computer, you old...

And so, as we leave Verity swearing at her colleague, Betty the Backup Bunnie says: 'Remember, Readers, a few minutes spent backing up your work is more than just a few minutes lost drinking time.'

This edition of Stob was sponsored by the HM Government Department for Getting People to do Sensible Things for Their Own Good. For a free leaflet, please write to the Abandoned Fridge, Unreported Gas Leak Road, East Condom, Cholesterolshire.

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